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START-UP PERFORMANCE OF GROUND-WATER RECHARGE TRENCHES ROCKY MOUNTAIN ARSENAL

by

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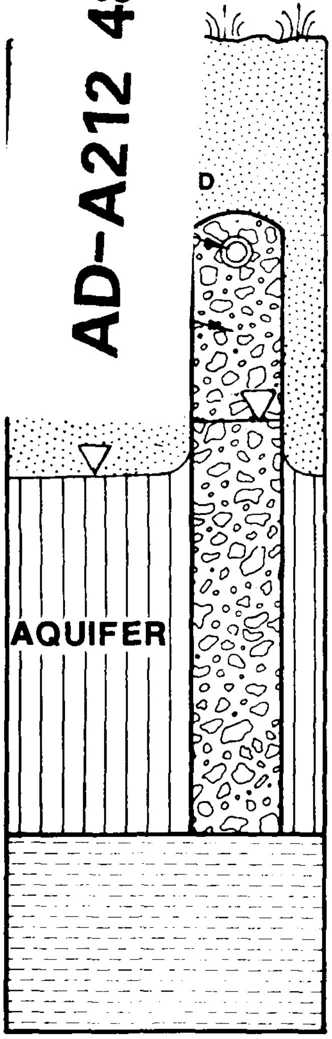

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The performance of ten gravel-filled trenches designed and constructed to recharge treated ground water to an alluvial aquifer was monitored through a 4-month start-up period. Trenches were 160 ft long and averaged about 16 ft deep in penetrating to the base of the unconfined aquifer. Flow capacities of individual trenches varied from about 2 to 40 gpm according to the variable nature of the alluvium. Water levels in 110 piezometers and wells were monitored weekly or more often within, downstream, and upstream of the trenches. Water levels rose as much as 11 ft adjacent to trenches. Water levels dropped in another large area when the rate of recharging through a surface infiltration pond was reduced. No deterioration of trenches was confirmed during start-up, and the system achieved the intended goals of a high rate of recharging and a favorable reversal of ground-water gradients.

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PREFACE

Field investigations were conducted by the US Army Engineer Waterways Experiment Station (WES) on the Rocky Mountain Arsenal (RMA) near Denver, Colorado, from October 1988 through April 1989. The Geotechnical Laboratory (GL) undertook this work for the Office of the Program Manager (PMO), RMA, to evaluate in a timely manner the effectiveness of ground-water recharging trenches recently added to the North Boundary Containment/Treatment Facility. Work consisted of close-interval monitoring of ground-water levels and water flows and analyses of these and other data as they reflect the operation of the enhanced recharge system. Day-to-day results were fed back, in turn, to fine-tune the start-up of the trenches.

The work benefited from close cooperation with the Technical Operations Division (TO), PMO, and DP Associates, Inc., the operator of the RMA Information Center (RIC). Contributors in this coordination were Messrs. Brian Anderson, TO, and David Strang, Chief, TO, who followed the progress of field work. Their understanding of the system in relation to its surroundings helped make the output of this study compatible with the experience of RMA. Also facilitating data collection and analysis were the operating personnel at the North Boundary Facility working under the supervision of Mr. Tom James, Chief, System Operations/Engineering Division, RMA. Ms. Dianna Reynolds wrote the new programs at RIC for plotting the water-level profiles.

The field and office studies and preparation of this report were accomplished by Dr. R. J. Lutton of the Earthquake Engineering and Geosciences Division (EEGD), GL. The work was funded through the Hydrogeology and Site Characterization Unit of which Dr. James May is Chief. General supervision was provided by Dr. L. M. Smith, Chief, Engineering Geology Branch, A. G. Franklin, Chief, EEGD, and W. F. Marcuson III, Chief, GL.

Acting Commander and Director of WES during preparation of this report was LTC Jack R. Stephens, EN. Dr. Robert W. Whalin was Technical Director.

CONTENTS

CONVERSION FACTORS, NON-SI TO SI (METRIC) UNITS OF MEASUREMENT

Non-SI units of measurement used in this report can be converted to SI (metric) units as follows:

Multiply	By	To Obtain
acres	4,046.873	square metres
degrees (angle)	0.01745329	radians
feet	0.3048	metres
gallons	3.785412	cubic decimetres
inches	2.54	centimetres
miles (US statute)	1.609347	kilometres
pounds (mass)	0.4535924	kilograms

START-UP PERFORMANCE OF GROUND-WATER RECHARGE TRENCHES

ROCKY MOUNTAIN ARSENAL

PART I: INTRODUCTION

1. This report describes the start-up of the new system for recharging treated water through gravel-filled trenches at the North Boundary Treatment/ Containment System (NBT) (Figure 1) at the Rocky Mountain Arsenal (RMA). The conceptual design of the trench system prepared late in 1986 has been published recently.* An implementation document** is on file in the RMA Information Center (RIC). Only a brief review of the trench system as installed in 1988 is necessary here.

Purpose of System

2. The Office of the Program Manager for RMA contamination cleanup regards the trench system as an interim remedial action. The NBT was previously deficient in its recharge functions, especially west of D Street, because of the chronically low capacity of its recharging wells. The new gravel-filled trenches were designed and constructed to increase NBT recharge capacity, to produce a favorable southward head gradient across the slurry-wall barrier, to improve the distribution of recharge water along the system, and to influence favorably the head gradient in the formation at depth.

Location and Arrangement

3. Ground water flowed naturally northward across the NBT area within a shallow aquifer of sand and gravel. The aquifer lies directly on bedrock of the Denver formation at a depth of about 16 ft. The geological setting is discussed further in Part IV.

4. Figure 1 shows the arrangement of the new trench system with respect to the RMA boundary and D Street, and the existing barrier, dewatering wells,

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* Lutton, R. J. "Conceptual Design Interim Ground-water Recharge System, RMA North Boundary Area," US Army Engineer Waterways Experiment Station, Miscellaneous Paper GL-88-35, December 1988.

** RMA reference number RIC 89139R01.

recharging wells, and monitoring wells. The dewatering wells are grouped into three manifolds as shown in the figure. The Denver dewatering wells, screened in the Denver formation, were not in use during start-up of the trenches and played no active part in the system. Also notice in Figure 1, the feature identified as a bog about 1,000 to 1,800 ft east of D Street. Prior to installation of the trenches the bog was used as a recharge basin, with substantial flow directed into the area. Much of the water to be recharged into the trenches was redirected from that previously flowing to the bog.

Water Distribution

5. The volume of water flow prior to trench recharging is summarized in Table 1. The period July 1986 through September 1987 for which the RIC had assembled summary data is considered representative of the pre-trench system. Dewatering wells extracted water from the aquifer south of the slurry wall, i.e. upstream of the barrier. Well water was collected via the three manifolds, A, B, and C, and transmitted for treatment in three granular-carbon columns identified correspondingly as adsorbers A, B, and C. Consistent differences in total flows through adsorbers A, B, and C partly reflect flow differences in portions of the aquifer dewatered by manifolds A, B, and C. The columns and plant have a design capacity of about 600 GPM but actual throughput has seldom exceeded about 280 GPM, the approximate limit of water acceptance by the recharging wells and bog.

6. After treatment, the water from all three adsorbers is filtered and stored in a sump as a means of regulating recharge. Treated water was pumped from the effluent sump to the recharging wells located north of the slurry wall, i.e. downstream of that barrier. Recharging wells were particularly susceptible to clogging and had become deficient in capacity. Periodic cleaning continues to be necessary. More than half the recharging in the 1986-1987 period was actually accomplished not through wells but instead by piping water from recharging wells RW-18 through RW-21 overland to the bog located nearby.

7. The distribution of treated water has been changed dramatically with the installation of the trenches. Prior to the trenches only about 50 to 60 GPM could be recharged through the wells in the western half of the NBT system. After the trenches began operating, the recharging to the same portion of the NBT system has been as great as 200 GPM.

Start-up Period

8. The start-up period was the 4-month interval from 31 October 1988 to 28 February 1989. Defining the end of the start-up period had been somewhat arbitrary. By the middle of January the system was approaching limiting water levels imposed by the bottoms of system manholes. Accordingly, some trench flow rates were reduced in anticipation of a condition of more or less stabilized flow.

PART II: DESIGN AND CONSTRUCTION

9. The trench system was proposed in 1986 as the best way of correcting deficiencies of the North Boundary system.* Gravel-filled trenches penetrating several feet into the aquifer were found to be substantially more effective for the North Boundary setting than the other options considered, i.e. wells, surface basins, and shallow gravel-filled trenches.

Design

10. The conceptual design consisted of a gravel-filled trench penetrating into the alluvial aquifer stratum. Recharge water was to be fed from one end longitudinally through a perforated plastic pipe near the top of the gravel interval. An impermeable membrane or filter fabric sheet was to separate the gravel interval from silty soil placed to the surface as backfill above. The fabric was also proposed to protect against lateral intrusion of silt as the water level fluctuated. Ten separate trenches were suggested to facilitate maintenance and control. Trench width was to be about 2 ft, depth was expected to average 15 ft, length was to be 100 ft, and offset from the barrier was to be 45 ft.

11. The final specifications and drawings of the system were prepared by Morrison-Knudsen Environmental Services (MKE) in mid 1987. Figure 1 shows the location of the ten trenches with respect to the barrier and Figure 2 is a typical cross section. Each trench included features recommended in the conceptual design: a prism of gravel of narrow size gradation, a filter fabric envelop minimizing the influx of silt, and a distribution system carrying water underground to a perforated pipe at the top of the gravel. In the foremost departure from the conceptual design, the trench lengths were increased to about 160 ft, thus allowing an extension of the trench line eastward to a point about 400 ft east of D Street.

12. The specified gravel, listed below, is somewhat coarser and more narrowly graded than had been proposed in the conceptual design:

* Lutton (1988).

Size	Percent Passing
1 in.	100
1/2 in.	0-40
3/8 in.	0-32
No. 4 sieve	0-3
No. 8 sieve	0-2

The fabric along the top and sides of the gravel prism is Phillips Supac 4 NP,* a 4-oz/yd^2 nonwoven polyester. Two observational piezometers were placed in each trench (Figure 2) and ten others were located between trenches and offset 25 ft south of the trench center line.

Construction

13. Part of the conceptual design** was focused on potential problems of instability when excavating into locally saturated, cohesionless soil. A sequence of steps in construction was outlined to facilitate rapid placement of gravel and reduce the stand-up time for precariously high trench walls.

14. Fortunately, when MKE constructed the system in August to October 1988, they encountered no unresolvable problems. Relative stability of trench wells was at least in part due to the fact that the water level was low and seldom much above bedrock, the ultimate depth of trenching. Hence, problems with saturation and concomitant weakening of soil were minor.

15. The use of a working bench also proved advantageous to stability. Figure 3 shows how 4 to 6 ft of the trench wall height was eliminated by excavation of this wide bench. The primary purpose of the bench had been to provide space to bury the possibly contaminated soil removed from the aquifer while trenching.

Survey Data

16. In the course of study of the system start-up, a problem with survey data was identified and investigated. The magnitude of this problem became evident when discrepancies were found between the elevations provided by MKE for new trenches and surrounding monitoring wells and well elevations

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* Mention of commercial products does not imply a recommendation.
** Lutton (1988).

previously placed intermittently in the file of RIC. The usual difference was lower elevations from MKE by approximately 0.9 ft. MKE has concluded that previous surveys used an errant benchmark, but independent confirmation of this explanation is lacking as yet.

17. There were numerous additional differences more likely related to breakage of individual well casing during grass mowing, etc. between the time the elevation was filed with RIC and the time of the MKE survey. Also, broken casing is often replaced with no attempt to regain the original elevation. Until a reliable survey of all points resolves the problems, the RIC file has remained unchanged except for addition of the new points.

18. Much of the description of the response of the water table in this report has been formatted in terms of relative water level changes over a given time interval. Survey discrepancies in true elevation are immaterial in that context. Also note that all but one of the profiles (Figure 4) now used routinely to monitor behavior of the water table (paragraph 27) are keyed to old RIC elevations and are more or less in accord one to another. The exceptional profile along the center line of the trenches uses new piezometers and the new MKE survey data at a position about 0.9 ft lower (paragraph 16).

PART III: START-UP OPERATIONS

19. The newly completed trench recharge system was started in operation on Monday, 31 October 1988 with 10 GPM going into trench 8. Four more trenches were activated later in the same week, and by 14 November all trenches were receiving recharge water.

Water Volumes and Sources for Trench Recharge

20. Water for the new trench system was obtained in two ways. First, the plant throughput was increased above that needed to handle the flux of ground water flowing across the system toward the north boundary. Table 2 shows that flow through the plant system was increased from about 215 GPM to about 300 GPM during the first month (November). Second, the recharge flow to the bog (paragraph 6) was reduced in increments by closing outlets at recharging wells RW-16 through RW-21. By 10 November water was being piped to the bog at only one well (RW-21). All recharge to the bog was stopped on about 11 January but was restarted on 19 January as equilibrium flow was approaching in the trenches.

21. Table 3 shows average flows recorded during the start-up period for recharging wells. These values were measured routinely by NBT plant personnel. Notice in particular the changes made in wells RW-16 through RW-21 used for distribution to the bog. Also notice that early in January all recharging wells west of D Street were shut off and remained idle for the remainder of start-up. Recharging through these wells had become counterproductive at this point in time since the water table had been raised sufficiently by trench recharging.

Flow History

22. Most of the history of recharging through the trenches is presented in tables of chronologically arranged data. Tables 4 through 13 present the pertinent flows accepted by the ten trenches from start to mid February. Table 14 presents a synopsis of the same flow measurements for the entire 10-trench system. As detailed in the table, over 23 million gallons of water were recharged to 10 February, and for the full four months the total exceeded

28 million gallons. Special effort was devoted early on to make the collection and processing of actual flow data a simple routine (paragraph 26). This task was to facilitate the routine plant control of recharge and to regulate the desired effects in the aquifer in a timely manner. In mid January the System Operations Division and the RIC began providing routine flow data. Table 15 shows the summary report for the interval 25 January to 1 March.

23. Table 16 summarizes how trench flow rates were manipulated during start-up. Each rate was set by manually adjusting the valve located in the trench manhole to the appropriate rate as indicated digitally on the readout board at the plant. A voice radio was used in coordinating between the manhole and the plant.

24. As indicated in Table 16 the trench rates were increased expeditiously and on about the 18th day were at their ultimate sustained rates. Some minor changes were made subsequently but the flow rates were mostly held constant for the next two months. Stabilization at these rates was permitted by indications that the desired reversal in gradient across the barrier (paragraph 2) was being achieved. At the same time there was a necessity to stabilize the amount of water being distributed to the bog in order to minimize the decline of the water table in the eastern portion of the NBT system.

Well Monitoring

25. A large set of existing wells was designated for monitoring changes in the water table from immediately south of the barrier northward to the RMA boundary fence. Most were shallow wells, limited to the alluvial aquifer of primary interest, but several deeper wells were included to monitor possible effects in bedrock. There were 40 newly designated wells, 17 wells previously measured weekly by the plant personnel, and 30 new piezometers installed within or near the trenches.* Most of these 87 wells lie along east-west lines adjacent to and north of the slurry barrier. Other wells not designated for monitoring at the start of this study were added for their usefulness in

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* The current, complete identification of wells and piezometers at NBT uses a 5-digit number beginning with the survey section number, i.e. 23 or 24. The section-number digits are omitted on maps and profiles where confusion is unlikely.

filling in the three-dimensional picture. Shortly into the study 110 available wells in the area were being monitored at least weekly, sometimes twice a week.

Reporting and Control

26. A special part of this study of start-up operations focused on quickly developing routine procedures for monitoring the response of the trench system and surrounding ground water to variations in flow rates. With suitable methods of collecting, presenting, and analyzing the water level and flow data, the plant personnel could confidently characterize the system and control its routine operation. A simple depiction of water-level changes with time which could be expeditiously processed by RIC and incorporated into their permanent cumulative record was needed.

27. The format proposed at the start of the study and refined during numerous meetings with personnel from Technical Operations Division, System Operations Division, and RIC was a series of east-west profiles (Figures 5 through 13). The profile lines (Figure 4) are located 20 ft south of the slurry barrier, 20 ft north of the barrier, along the trenches 45 ft north of the barrier, and along the perimeter road 400 ft north of the barrier. Notice that Figures 7, 9, 11, and 13 extend the full length of the barrier whereas the other profiles present the same data only in the trench interval. The horizontal positions along the profile lines have been slightly distorted to permit direct comparison from one line to another and to meet the constraints of the RIC processing.

28. Water-level profiles generated for 3 March are shown in Figures 5 through 13. Selected previous elevation profiles, including the start-up baseline of 29 October, are typically added for comparison and to reveal up-to-date trends. Notice that Figures 12 and 13 present a comparison of water levels immediately north and south of the barrier for five dates in time.

29. As a part of operational routine, water depths are now measured and reported weekly by plant personnel. These data are passed through channels to RIC for processing. At the end of the start-up period, profiles were being produced routinely about once a month but a one-day turn-around was possible when needed for special reports.

PART IV: ALLUVIAL AQUIFER RESPONSE

30. A response of the alluvial aquifer to recharging was detected within a few days in some piezometers and wells adjacent to active trenches. Within two weeks, as recharge rates were increased, a recognizable rise in the water table had begun along the RMA boundary fence, 350 ft to the north. The rise continued more than 16 weeks and even after reductions in flow rate were begun late in January.

Hydrological Setting

31. The geology and hydrology of the North Boundary area has been studied extensively in the past. Geological logs were prepared during installation of dewatering, recharging, and monitoring wells, and these logs formed an unusually extensive data base. A geological synthesis was subsequently accomplished.* Figure 14 shows a modification** of those interpretations, updated with geological information not previously included in the interval of the pilot recharge system (wells RW-1 through RW-12).

32. The aquifer of sand and gravel occupies a very broad north-northeast-trending paleodrainage low, but this alluvial lens is obscured by a thick surficial layer of fine-grained soils, in part of eolian origin. Bedrock consists of siltstone and shale of low permeability interbedded with sandstone layers of modest permeability. Figure 14 shows the nature of the soils and bedrock along the line of recharging wells. Where discontinuous, the alluvial layer has apparently been eroded and replaced by channel fill of clay and clayey sand, as for example in wells RW-21 and RW-32 (Figure 14). Alluvium thickness is approximately 8 ft and that of the overlying clay and silt about 8 ft. The water table is mostly below the top of the alluvial layer so that the aquifer is largely unconfined.

33. The water table for the entire RMA is generalized in Figure 15 with 10-ft contours for mid 1981. The water table was then little affected by the NBT system which at that time had only been constructed to the pilot stage.

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* Berry, E. W., Anderson, B. L., May, J. H., Hunt, R. W., and Thompson, D. W. 1985 (Dec). "North Boundary Containment/Treatment System Performance Report, Rocky Mountain Arsenal, Denver, Colorado," US Army Materiel Command, Volume II.

** Lutton (1988).

Ground water flows generally northwest. Near the NBT facility the northwest inclination of the water table is complicated by a local flat inclined very slightly to the northeast and promoting flow in that direction (Figure 16). The bench reflects a largely continuous, paleodrainage feature also evident in the configuration of the top of rock. Note that this flat in the water-table surface is too subtle to appear in Figure 15. Nevertheless, the northward flow dominates ground-water hydrology at the NBT.

Rising Ground Water

34. The response of the ground water to recharging through trenches is illustrated in Figures 17 and 18. Separate viewpoints of the same actions are presented in the profiles in Figures 5 through 13. It can be seen that a predictable rise occurred at high recharge rates and that the effect extended horizontally to a great distance though with an expected delay. Water levels through time are tabulated in the appendix. Of particular significance is Figure 12 in which the progressive change in the gradient across the barrier from mostly northward and unfavorable to entirely southward and favorable is followed with time. It can be seen in comparison to Figure 6 that one major interpretation was made in arriving at the profiles north of the barrier. Piezometer 23516 was omitted. That piezometer lagged in response and the water level there remained anomalously low throughout start-up. It was concluded that clay or shale encountered in augering this well prevented a normal response in accord with the rest of the aquifer. The clay may be a channel fill such as discussed in paragraph 32.

35. Table 17 reveals water-table behavior according to various recharge rates, trench by trench. Flow rates at which the water level continued to rise are listed on the left and rates at which water level dropped are on the right. The implication is that the two sets of flow rates bracket rates at which the water table would have remained stable. These equilibrium rates listed on the right may change somewhat according to the elevation to be maintained in the trench, i.e. an equilibrium rate may be increased slightly by increasing to a higher trench-water elevation.

Falling Ground Water

36. A persistent lowering of the water table occurred east of the trench system as a result of the redistribution of water from recharging through the bog in order to recharge the trenches (paragraph 20). The effects are illustrated in Figures 17 and 18. The lowered water table is seen from different viewpoints in Figures 7, 9, and 11. The contrast with a raised water table on the west is conspicuous. Figure 13 reveals that the resultant unfavorable, northward gradient across the barrier persisted throughout start-up. Water levels through time are tabulated in the appendix.

Effects of Interruptions

37. The response of the water levels to short-term interruptions was investigated on the occasion of a plant shut down for changing carbon in the adsorbers on 22 November. Figure 19 shows how water levels in and adjacent to trenches 7 through 10 declined in the 2-hr period of no flow. The interruption started at about 10:00 in the morning and flow was restarted between 11:50 and 12:05. All water levels had been rising rapidly in the previous three days. The initial positions were not measured but were approximated confidently by depths measured at other times on the same day. These approximations were found to agree with levels projected from levels measured on 19 and 21 November.

38. The response to the 2-hr interruption was characterized by drops of as much as 1 ft within the high-capacity trenches 8 and 9. Seventy-five percent of the decline occurred prior to 25 min, so the early response with time can be described as exponential. In contrast, the water table away from the trenches was hardly affected in the 2-hr period. Water levels in exterior piezometers 24503, 23501, and 23217 remained slightly above their initial positions, suggesting that the water table may have continued to rise slowly at distances of 40 to 90 ft from these trenches.

Effects South of Barrier

39. Water table behavior south of the barrier is best analyzed by examining in detail the changes in water levels along the profile offset to

the south. Figures 8 and 9 reveal that the water table south of the barrier rose along the western half of the system, possibly in part in response to the large rise in the water table around trenches north of the barrier. Conversely, the eastern half experienced the opposite effect, a falling water table over the period of start-up (Figure 9). Between 29 October and 27 January the rise on the west was as much as 0.61 ft (well 23212). The fall on the east was as much as 1.50 ft (well 24183). The actual readings are tabulated in the appendix for each monitoring well.

40. Hydrological mechanisms for the generally rising water table on the west and falling water table on the east (south of the barrier) seem limited to the following possibilities:

- a. Very slow flow through the barrier, along distributed cracks or slightly permeable soil streaks.
- b. Slow flow under the barrier via a bedrock sandstone.
- c. Localized flow under or through the barrier, e.g. along one or more thin fissures.
- d. Seasonal fluctuations behind the barrier.
- e. Major variations in dewatering rates.

A combination of mechanisms is also possible. Data are sufficient to evaluate the importance of seasonal fluctuations only.

41. To explore the nature of seasonal fluctuations, the cycle of water level was reviewed for monitoring wells south of the dewatering wells. These wells have been monitored routinely by the personnel from the North Boundary plant over a period of years. Total rises and declines in the 3-month period November through January are shown in Table 18 for wells 23120, 24129, and 24150 in three consecutive winters. In the case of 23120 the seasonal trend repeats and therefore seems to explain the similar rise in water table immediately south of the barrier west of D street (paragraph 39). The closest monitoring wells, 23212 and 23213, showed comparable rises of 0.61 and 0.37 ft, respectively.

42. The upstream well 24150 shows a very close correlation with the dropping water table profiled south of the barrier east of D street (Figure 9), but there is a conspicuous contrast with the rising water table at this period in the previous two winters (Table 18). Part of the seemingly erratic correlation with seasonal trend east of D street is likely due to the

fact that the start-up period came between the dry and wet periods. The drop in water table in 24150 and elsewhere south of the barrier for 1988-1989 reflects at least in part a delay of the large wet-season ground-water rise along First Creek as compared to that in the previous two years.

43. In view of the uncertainty about the seasonal fluctuations of the water table immediately south of the barrier, other, more subtle effects and the possibility of leakage through or under the barrier remain even more speculative. It does appear, however, that slow flow through or under the western half of the barrier if present at all, is not an operational problem. Recharging in the trenches developed a favorable southward head difference of as much as 6 ft across the barrier with at most a 0.6-ft rise occurring on the south side, and that rise was more likely seasonal. A full explanation of changes south of the barrier should await the collection of more data and development of a complete seasonal cycle.

PART V: RESPONSE IN BEDROCK

44. The water levels in monitoring wells screened in Denver formation bedrock have responded during trench recharging over the entire area, both north and south of the barrier. The changes are generally similar, although usually less in magnitude and somewhat delayed in time in comparison to those in alluvium (PART IV). Although two or more separate sandstones have been distinguished in the past and wells have been screened in each, Denver formation wells are grouped together here. Distinguishing separate responses in each sandstone appeared unpromising and was not attempted.

Increasing Head

45. A direct effect of recharging through the trench system was a slow increase in the head as measured in Denver formation monitoring wells. Figures 20 and 21 show these increases across the western half of the system for two intervals during start-up. Notice in particular the appreciable rise in wells 23176 and 23177 located across the barrier from trenches 6 and 7. The overall rise in Denver formation water levels is generally similar to but slower than that occurring in the alluvial aquifer above (Figures 17 and 18). Two wells are anomalous and should be ignored. Wells 23226 and 23235 showed rapid, large rise in close accord with alluvial wells nearby. Direct, short-path communication with alluvium is evident.

Decreasing Head

46. An indirect effect of the recharging start-up has been a slow decrease in head in the Denver formation within the area of influence of the bog. As flow to the bog was reduced during start-up (paragraph 20), there was a decrease in head corresponding to the drop in water table in the alluvium. The effect is illustrated in Figures 20 and 21 for two intervals in the start-up period. The head drop is similar to that occurring in the alluvial aquifer positioned above (Figures 17 and 18) but much smaller. Two wells behaved anomalously and apparently do not represent bedrock ground water. Well 23125 showed falling water level in an area of section 23 where a small rise was

prevalent. Well 24172 showed a large fall more characteristic of a well with short-path communication with alluvium.

Relation to Alluvial Aquifer

47. The close relationship between the responses of water heads in the Denver formation and in the alluvium indicate that some degree of communication exists. Such communication may locally take place through the edges of truncated permeable sandstone layers at their intersection with the overlying permeable alluvium. Other paths for transmission of water and water pressure from the alluvium to the bedrock are fissures, partings, and breccia. These porous zones provide a simpler explanation than the one based on connecting thin sandstone lenses from well to well and to the top of bedrock in the stratigraphically complex Denver formation. The geological cross section in Figure 14 illustrates the considerable interpretation required in projecting sandstone layers.

48. Three wells are particularly revealing in regard to the nature of water pressure in the bedrock. Wells 23202, 23203, and 23204 are screened in the Denver formation but their rapid response is that of the alluvial aquifer. The screens are situated several feet below the top of rock where they apparently have efficient, short-path communication with the alluvium through a layer of breccia or heavy jointing localized near the old ground surface. Similarly anomalous behavior in bedrock wells is noted in paragraphs 45 and 46.

49. The clearest expression of the response of ground water in bedrock to the recharging through the trenches in alluvium was found in two Denver wells located south of the barrier (Figure 22). Water levels in wells 23176 and 23177 rose 2.11 and 2.30 ft, respectively during the four months of start-up. Alluvial wells 23213 and 23212, located nearby and also south of the barrier, showed water levels up by 0.60 and 0.72 ft, respectively in the same period. The much larger rise in bedrock head is directly related to the heavy recharging immediately north of the barrier. In fact, it has been reasonable to contour the water-level changes in bedrock in the figure. Notice that the large changes of 6.83 and 4.26 ft in wells 23235 and 23226 have been ignored in contouring the data. These changes are like those in alluvial wells nearby and are considered to represent alluvial response not bedrock response.

50. It is suggested that the water and water pressure gradient follow permeable strata, fissures, and partings passing beneath the barrier. Apparently the trench recharging into alluvium beneficially altered the water pressure in bedrock as well as alluvium and continues to work toward a favorable southward gradient (paragraph 2).

PART VI: CAPACITY OF TRENCHES

General

51. The cost effectiveness of the trench recharging system will be in proportion to the length of service at a high flow rate. In this context near-term physical deterioration of the system such as plugging of pores might constitute a serious problem. Accordingly, particular care was given in this study to monitoring for indications of deterioration. Effects attributed to deterioration were not recognized during the short term of the start-up operations. Water levels continued to rise at the high flow rates set in mid November (Table 16). Recharge rate of the trench system ranged as high as about 200 GPM. By February water levels had reached limits in some trenches predetermined by the bottoms of the manholes (Figure 5).

52. Flow rates were adjusted downward late in the start-up period for two reasons. First, water had to be kept out of the manholes to avoid flooding valves and meters. Second, as a matter of ground-water management policy, water levels measured in wells along the boundary fence (Figures 10 and 11) were constrained to the configuration of ground water prior to the NBT system. With water levels still rising, it was not clear in February to what extent aquifer space downstream was still filling. Even further decreases in flow rates were anticipated as necessary in reaching ultimate rates and equilibrium sometime after the start-up period.

53. Several sets of flow rates are helpful in summarizing the changes made during start-up. Table 19 presents average flow rates for three weeks in February near the end of the start-up period. These rates at the time of approaching stability are taken from the RIC trench data tabulated in the appendix. Table 15 shows earlier flow rates, extracted from Tables 4 through 14. The column for the interval 29 November to 7 December is particularly important. Recharging was then at sustained high flow rates near 200 GPM, yet the system had been operating only a few weeks. The comparison of Tables 15 and 19 reveals the definite decrease in trench flow brought about during start-up. As explained in paragraph 52, this decrease followed management decisions to stabilize water levels.

Analysis of Filling Capacity

54. The flow capacity which had been predicted in the conceptual design exceeded the maximum flow rate experienced during start-up by a factor of four. Flow rate had been estimated* to be 0.0305 GPM per square foot of aquifer on the basis of flow rates achieved in NBT recharging wells shortly after installation. Assuming that the trench intersection within the aquifer averages 8 ft deep (paragraph 32), the total area along the two sides of the ten 160-ft trenches is 25,600 ft^2. Total flow at the predicted capacity should have been 780 GPM rather than the 194 GPM actually achieved as a maximum (Table 14). This difference is at least partly explained by the prudent conservatism exercised during the first few weeks of start-up. The saturated thickness was only about 1 ft and considerable pore space was available in the aquifer. Accordingly a much higher flow rate could have been achieved, probably well in excess of 200 GPM and possibly as high as 780 GPM (except for the limitations of the NBT plant).

Analysis of Equilibrium Flow

55. The achievement of equilibrium, saturated flow shortly after the end of the start-up period allows a calculation of the coefficient of permeability (k) which, in turn, serves to show the validity of Darcian hydraulics for designing trench installations. The analysis is limited here to trenches 4 through 10 where a condition of equilibrium was confirmed from stabilization of water levels monitored downstream in wells 23110 and 23111 (Table 20).

56. According to Darcy's law in simplified form

$$k = \frac{Q}{A\,i}$$

where

Q = quantity of water per unit time

A = cross-sectional area through which Q flows

i = hydraulic gradient, i.e. head loss per unit distance

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* Lutton (1988).

Consider an east-west cross section lying between the trenches and the two monitoring wells. Assume that the aquifer averages 8 ft in thickness along the 2150-ft distance from the west end of trench 4 to the east end of trench 10. The cross-sectional area A is 17,200 ft^2. The equilibrium flow Q near the end of March is approximately 128 GPM (Table 20) or 17.114 ft^3/min. The hydraulic gradient i from the vicinity of the trenches to the two monitoring wells averaged 0.0109 at the stable flow. The calculated value of k is 0.09128 ft/min or 4.637×10^{-2} cm/s, about typical of clean, coarse sand. This value is only slightly lower than values of k calculated in 1978* from pumping tests conducted at a location about 2,000 ft south of the trenches. Values there ranged from 5.3×10^{-2} to 13.8×10^{-2} cm/s according to the assumptions and methods of calculation. Most calculated values were less than 8×10^{-2} cm/s.

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* RMA reference number RIC 81266R70.

PART VII: CONCLUSIONS

57. Several important findings resulted from this start-up study. The trench system functioned satisfactorily during its first four months, and with continued operation, the system is becoming important as a prototype of a promising new method of recharging in cleanup technology.

Alluvial Gradient Reversal

58. Ground water was raised as much as 11 ft by trench recharging during start-up. This change reversed the ground-water gradient in alluvium across the slurry wall along the entire trenched interval. The head difference locally reached as much as 6 ft before the flow rates were reduced late in start-up.

Beneficial Bedrock Effects

59. Recharging the alluvial aquifer had a beneficial effect on the ground-water regime within the Denver formation below. The bedrock head was raised in a large area around the trenches. This effect even extended southward beneath the slurry wall, indicating that any previously existing potential for movement of contaminated water northward beneath the barrier (if present at all) has been eliminated.

Trench Capacity and Control

60. The recharge trench system accepted water at rates up to 200 GPM. Recharge flow was gradually reduced to 160 GPM at the end of start-up as equilibrium approached. Equilibrium flow will be even lower particularly if the water level is maintained at a lower position. A lower water level is a likely future option since the head difference across the barrier on the west is much more than necessary, and recharging needs to be increased on the east where an unfavorable gradient has continued. Trenches have been clearly shown to be useful in controlling water distribution within their area of influence.

Limitations of Recharge Trenches

61. The construction of deep gravel-filled trenches for recharging is potentially difficult due to possible instability of trench walls in aquifer strata. However, trench construction was successful at NBT, where the water table in the aquifer had been lowered for a long period and the soils had gained strength sufficient to remain stable. Under less favorable, high-water conditions the method used at NBT is yet to be confirmed as feasible. Another method might have to be employed.

62. A second possible limitation on trench recharging involves the accumulation of particulates or bacterial growth. Dissolved or particulate matter and bacterial action would potentially plug the voids within or immediately adjacent to the trenches. The occasional movement of carbon fines into the NBT recharging wells has caused concern in the past. The System Operations Division considers that the amount of carbon fines in the treated effluent is no longer a serious problem. Additionally, the organics being removed in the NBT plant should tend to kill bacteria otherwise participating in the precipitation and plugging processes. The system functioned during the short-term period of start-up without recognizable signs of deterioration in recharging. Nevertheless, the degree of long-term plugging remains an open question that should be clarified in continuing long-term studies as recommended in paragraph 63.

Long-term Study

63. The monitoring and analysis of the performance of the trench system beyond start-up is seen as a useful follow-up to the present study. Emphasis should be on the characterization of routine operation to reveal the balance of dewatering and recharging flows and the response of the flow system and ground water to routine adjustments, seasonal variations, and interruptions. The question of long-term deterioration will be clarified so that future maintenance or possible installation of a second-generation trench system can be planned more effectively. As a part of the long-term study, it will be possible to check existing ground-water models, both empirical and deterministic, for suitability in predicting response to routine operation of the system.

PART VIII: SYSTEM EXPANSION*

64. Based on the experience derived from installing and operating the ten recharge trenches, it is suggested that similar new trenches be installed in the eastern portion of the NBT. The performance of the existing trenches on the west has been satisfactory as manifested both in the large volume of water recharged and in the rise in the water table immediately north of the barrier (Figure 23). This rise has established a strong favorable gradient southward across the barrier.

65. The concomitant reduction in water flow to the bog (Figure 1) has caused the water table nearby to drop and has locally increased the unfavorable northward gradient across the barrier already present on the east (Figure 13). The addition of new recharge trenches on the east is considered to be adequate for ultimately correcting the local problem of unfavorable northward gradient there.

66. The technical features of the system extension are presented below:

a. Trench arrangement: The extension should consist of approximately nine new trenches with length, spacing, and setback from the barrier approximately the same as previous trenches (Figure 24).

b. Depth: The water table in the extension area is mostly 10 to 13 ft below ground surface. Previous trenches 1 through 10 were constructed with the water table at substantially greater depth, mostly 13 to 18 ft, and close to bedrock. The low water favored wall stability. Although the hope is to reach bedrock and achieve full penetration of the aquifer, some new trenches may have to be completed at bottom depths above bedrock. Nevertheless, a diligent effort, including the consideration of techniques to minimize instability, should be made to reach bedrock. For example, the working bench utilized previously might be carried deeper to reduce trench wall height. Where the stabilization efforts prove fruitless, the gravel trench should be completed with the thickest possible penetration of the aquifer. A penetration of less than 3 ft into very permeable sand should usually be considered unsatisfactory.

c. Water system: The piping, flow meters, and valves for the existing ten trenches have mostly performed satisfactorily. A similar system should be used in the extension trenches. Manholes should be located at the uphill ends of trenches to facilitate flow. Meter size should be carefully evaluated in view of low-flow problems with meters in old trenches 1, 2, and 3. Also see e. System Flow below.

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* This section utilizes some data collected in April 1989 after start-up.

d. Gravel prism: The features of the gravel prism and fabric envelop within each trench should remain approximately as before in view of the satisfactory performance. Details not clearly defined in the previous work include the closure of filter fabric around the ends of each trench and around the two piezometers where they penetrated the gravel-soil interface. It should be made clear in design that these potential paths for silt infiltration are blocked.

e. System flow: The extension area has broad zones of high flow rates as revealed by well pump tests.* Therefore, the flow capacity and eventual equilibrium flow of new trenches are expected to be at least as great as have been achieved through trenches 1 through 10, with initial capacity exceeding 200 GPM.

f. Start-up: Limitations on water supply may prevent the starting of several new trenches at high flow rates while maintaining old trenches at current rates. It is proposed that only a few new trenches be operated at first and that water come from reductions in flow to trenches 1 through 10 and the recharging wells. Starting only a few trenches could allow an evaluation of the effectiveness of trenches at wider spacing. Idle trenches could be activated later as needed.

67. Operation of the trench system extension will obviate surface recharging through the bog. Figures 25 and 26 represent for comparison the ground-water profiles for bog recharging and trench recharging, respectively. Figure 25 shows profiles of 15 January, 17 February, and 1 April 1989 based on measurements in monitoring wells. The variation in the profiles reflects different recharge rates through the bog. The profile gradient in Figure 26 is an average of four gradients measured on 3 March north from trenches 5 through 10. The recharge rate at the bog is approximately 120 GPM and this is approximately what was fed through trenches 7, 8, and 9 during start-up. Accordingly recharging through new trenches opposite the bog can be expected to maintain a small favorable gradient across the barrier as shown in the figure while not raising water levels at the bog or at the north boundary. Notice in the figure that water may still stand passively in the bog.

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* Lutton (1988).

Table 1

Water Flow (GPM) Prior to Trench Recharging*

Adsorber	Jul 86	Aug 86	Sep 86	Oct 86	Nov 86
A	77.72	70.70	69.68	54.76	56.55
B	110.48	112.29	107.35	114.22	117.64
C	105.83	112.71	120.82	142.23	139.37
SYSTEM	294.03	295.69	297.85	311.21	313.55

Adsorber	Dec 86	Jan 87	Feb 87	Mar 87	Apr 87
A	51.56	49.31	31.75	31.98	37.10
B	102.59	106.67	62.14	46.83	54.59
C	138.68	145.31	105.67	117.07	114.21
SYSTEM	292.83	301.29	199.56	195.89	205.89

Adsorber	May 87	Jun 87	Jul 87	Aug 87	Sep 87
A	44.07	41.96	39.79	83.68	62.39
B	71.83	76.18	81.08	95.80	90.26
C	111.34	87.13	93.90	100.84	89.12
SYSTEM	227.24	205.27	214.76	280.32	241.76

* From RIC

Table 2

Average Flow Rates (GPM) Plant Adsorbers During Start-up

ADS.	28 Sep to 5 Oct	5 Oct to 12 Oct	12 Oct to 19 Oct	19 Oct to 2 Nov	2 Nov to 9 Nov
A	44.871	34.565	52.238	49.530	52.103
B	75.615	88.296	80.069	72.158	76.984
C	87.708	80.387	112.960	94.297	109.762
SYSTEM:	208.194	203.248	245.267	215.985	238.849

ADS.	9 Nov to 16 Nov	16 Nov to 23 Nov	30 Nov to 7 Dec	7 Dec to 14 Dec	14 Dec to 21 Dec
A	55.482	54.746	61.459	63.043	54.558
B	83.386	97.343	106.551	103.389	100.943
C	111.202	121.936	141.588	136.462	131.787
SYSTEM:	250.070	274.025	309.598	302.894	287.288

ADS.	21 Dec to 28 Dec	28 Dec to 4 Jan	9 Jan to 18 Jan	18 Jan to 25 Jan	25 Jan to 1 Feb
A	54.626	52.939	54.459	51.196	49.960
B	100.248	100.694	103.431	97.360	101.879
C	121.299	126.609	140.178	141.558	147.674
SYSTEM:	276.173	280.242	298.068	290.114	299.513

ADS.	1 Feb to 8 Feb	8 Feb to 16 Feb	16 Feb to 22 Feb	22 Feb to 1 Mar	1 Mar to 8 Mar
A	51.402	52.476	45.724	46.505	45.544
B	95.636	100.173	97.312	95.327	93.552
C	142.266	141.056	137.555	142.644	138.907
SYSTEM:	289.304	293.705	280.591	284.476	278.003

From RIC

Table 3

Average Flow Rates (GPM) Recharge Wells During Start-up

Well RW-	28 Sep to 5 Oct	5 Oct to 12 Oct	12 Oct to 19 Oct	19 Oct to 2 Nov	2 Nov to 9 Nov
1	0.231	0.266	0.277	0.144	0.270
2	1.027	1.637	3.263	1.674	1.601
3	0.238	0.104	0.123	0.099	4.486
4	3.670	0.570	0.539	0.294	0.464
5	0.445	0.481	0.425	0.187	0.300
6	0.205	0.299	0.178	0.092	0.293
7	0.378	0.490	0.461	0.222	0.457
8	0.915	1.517	2.199	1.248	2.588
9	0.822	0.306	0.025	0.000	0.001
10	0.247	0.221	0.192	0.090	0.193
11	7.926	5.717	4.323	0.174	0.124
12	1.392	1.211	1.088	0.436	0.774
13	0.974	0.776	0.672	0.262	0.481
14	0.156	0.002	0.001	0.000	0.001
15	2.226	2.504	2.702	0.002	0.002
16	25.407	26.091	37.517	0.209	24.764
17	37.013	33.867	43.074	21.274	26.684
18	21.059	19.002	24.478	11.996	16.410
19	29.767	26.853	35.542	15.726	25.085
20	29.481	27.100	35.716	16.642	26.219
21	28.215	25.592	27.980	4.728	12.070
22	6.060	6.212	6.958	2.889	4.564
23	5.933	7.594	10.097	5.183	9.322
24	2.751	3.377	4.725	2.281	4.218
25	4.522	4.216	4.293	1.816	3.382
26	7.540	5.490	5.321	2.366	4.659
27	1.076	11.123	11.772	0.473	8.106
28	2.579	3.207	4.048	0.202	3.276
29	1.864	2.337	2.452	1.139	1.917
30	2.369	3.512	8.208	3.068	3.378
31	0.468	2.123	4.675	1.294	1.743
32	2.947	3.466	3.648	0.834	3.375
33	0.192	0.290	0.303	0.260	0.458
34	0.685	2.186	2.407	0.006	0.007
35	1.868	3.522	3.634	1.861	3.271
36	0.399	0.674	0.679	0.146	0.312
37	0.420	1.114	0.903	0.331	0.685
38	0.599	1.245	0.952	0.366	0.614
SYSTEM:	234.066	236.294	295.850	100.014	196.554

From RIC

Table 3 (Continued)

Well RW-	9 Nov to 16 Nov	16 Nov to 23 Nov	30 Nov to 7 Dec	7 Dec to 14 Dec	14 Dec to 21 Dec
----	-----	-----	-----	-----	-----
1	0.069	0.239	0.217	0.183	0.337
2	1.887	0.820	0.870	3.791	3.617
3	5.421	4.049	4.389	3.201	0.941
4	0.526	0.484	0.859	5.526	7.200
5	0.305	0.295	0.168	0.724	1.584
6	0.188	0.224	0.129	0.028	0.435
7	0.468	0.435	0.458	1.106	2.333
8	2.077	2.447	1.688	0.258	0.000
9	0.003	0.001	0.001	0.000	0.000
10	0.187	0.187	0.162	0.169	3.094
11	0.099	0.165	0.009	0.010	0.015
12	0.709	0.598	0.429	0.361	0.588
13	0.434	0.395	0.323	0.327	0.771
14	0.004	0.013	0.002	0.002	0.003
15	0.031	0.016	0.013	0.004	0.004
16	4.006	2.954	3.396	2.321	2.556
17	3.804	3.213	3.286	2.558	2.536
18	6.757	6.436	6.766	4.179	1.206
19	8.714	8.154	9.158	6.592	6.520
20	4.498	9.148	4.518	3.380	3.227
21	24.447	31.591	6.164	18.153	18.903
22	4.386	4.004	4.196	2.987	2.912
23	8.277	6.409	6.192	3.017	2.617
24	3.751	3.667	3.674	3.202	3.100
25	3.225	3.051	3.039	2.788	2.791
26	3.701	3.429	3.097	2.965	3.137
27	7.533	0.006	6.379	4.048	3.131
28	3.428	2.721	3.369	3.004	2.229
29	2.259	2.114	2.246	1.687	1.029
30	7.746	5.514	4.138	4.062	2.423
31	3.996	3.403	1.488	1.382	1.467
32	3.232	3.633	6.375	10.741	1.227
33	0.450	0.461	0.422	0.430	0.470
34	0.294	0.014	2.103	1.551	1.289
35	3.306	2.701	2.738	2.889	1.877
36	0.284	0.283	0.248	0.229	0.224
37	2.532	0.617	0.578	0.550	0.545
38	0.725	0.567	0.511	0.578	0.628
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SYSTEM:	123.759	114.458	93.798	98.983	86.966

Table 3 (Continued)

Well RW-	21 Dec to 28 Dec	28 Dec to 4 Jan	9 Jan to 18 Jan	18 Jan to 25 Jan	25 Jan to 1 Feb
1	0.152	0.140	0.000 *	0.000	0.000
2	0.980	0.647	0.000	0.000	0.000
3	1.034	0.753	0.000	0.000	0.000
4	0.275	1.476	0.000	0.000	0.000
5	0.000	0.287	0.000	0.000	0.000
6	0.000	0.244	0.000	0.000	0.000
7	0.002	0.831	0.000	0.000	0.000
8	0.000	0.216	0.000	0.000	0.000
9	0.000	0.000	0.000	0.000	0.000
10	9.782	8.785	0.000	0.000	0.000
11	0.063	0.040	0.012	0.000	0.000
12	3.687	3.604	2.672	2.259	2.114
13	5.980	9.193	7.910	6.299	5.505
14	0.007	0.015	5.014	4.378	4.042
15	0.007	0.004	4.646	4.167	4.155
16	4.009	10.315	14.292	14.145	17.358
17	3.113	9.620	8.865	7.837	7.751
18	0.424	1.298	0.597	0.080	4.858
19	7.811	6.624	8.567	11.499	6.762
20	3.558	3.058	3.744	3.666	3.711
21	21.983	19.901	13.433	21.708	20.701
22	4.113	3.754	4.575	4.620	5.704
23	4.007	2.590	2.507	1.792	1.139
24	3.004	3.067	3.182	3.215	3.739
25	2.900	2.985	3.282	3.286	3.806
26	3.250	3.257	3.114	2.830	2.844
27	5.005	3.808	5.312	4.531	4.221
28	3.521	3.005	4.377	3.131	3.483
29	1.542	1.470	2.000	2.028	2.159
30	7.104	6.117	9.484	9.793	11.677
31	1.699	3.673	3.971	4.009	4.578
32	1.644	1.267	0.000	0.000	0.000
33	0.368	0.393	0.000	0.000	0.000
34	1.202	1.041	0.000	0.000	0.000
35	2.156	1.729	0.000	0.000	0.000
36	0.183	0.185	0.000	0.000	0.000
37	0.434	0.397	0.000	0.000	0.000
38	0.355	0.397	0.000	0.000	0.000
SYSTEM:	105.354	116.186	111.556	115.273	122.307

* Shut down RW-1 to -11 and RW-32 to -38 for remainder of start-up.

Table 3 (Concluded)

Well RW-	1 Feb to 8 Feb	8 Feb to 16 Feb	16 Feb to 22 Feb	22 Feb to 1 Mar	1 Mar to 8 Mar
----	-----	-----	-----	-----	-----
1	0.000	0.000	0.000	0.000	0.000
2	0.000	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000	0.000
5	0.000	0.000	0.000	0.000	0.000
6	0.000	0.000	0.000	0.000	0.000
7	0.000	0.000	0.000	0.000	0.000
8	0.000	0.000	0.000	0.000	0.000
9	0.000	0.000	0.000	0.000	0.000
10	0.000	0.000	0.000	0.000	0.000
11	0.000	0.000	0.000	0.000	0.000
12	3.877	9.584	11.066	10.303	0.338
13	4.918	4.202	3.655	3.280	2.949
14	3.847	3.398	3.071	2.736	1.074
15	4.647	3.639	3.277	3.120	3.007
16	12.177	16.467	8.591	10.195	10.679
17	7.001	6.194	5.069	4.080	3.355
18	10.420	13.341	12.103	9.850	7.845
19	8.376	7.694	7.088	6.780	6.372
20	3.531	3.282	2.897	25.051	33.653
21	19.852	21.508	21.439	23.325	21.757
22	4.950	5.683	4.403	3.105	2.888
23	1.294	0.995	0.722	0.585	0.368
24	3.995	6.502	5.511	4.065	3.225
25	3.857	6.506	4.735	4.024	3.145
26	2.801	3.475	3.583	2.887	2.286
27	1.456	4.246	4.119	3.424	2.755
28	4.289	5.520	5.396	4.465	3.706
29	2.202	2.113	2.030	2.041	1.949
30	12.923	16.233	14.921	14.641	13.711
31	4.685	4.538	4.515	4.583	4.446
32	0.000	0.000	0.000	0.000	0.000
33	0.000	0.000	0.000	0.000	0.000
34	0.000	0.000	0.000	0.000	0.000
35	0.000	0.000	0.000	0.000	0.000
36	0.000	0.000	0.000	0.000	0.000
37	0.000	0.000	0.000	0.000	0.000
38	0.000	0.000	0.000	0.000	0.000
	-------	-------	-------	-------	-------
SYSTEM:	121.098	145.120	128.191	142.540	129.508

Table 4

Trench 1 Recharge 14 November to 10 February

Time				Time Interval min	Cumulative Flow gal	Interval Flow gal	Average Flow Rate GPM	Remarks
Month	Day	Hour	Minute					
11	14	14	50	0	27	0	--	Started at 5 GPM
11	16	13	40	2,810	7,590	7,563	2.7	
11	16	15	00	80	7,590	--	--	
11	16	15	00	0	0	0	--	Reset totalizer
11	29	13	50	18,650	61,730	61,730	3.3	
12	07	06	46	11,096	139,975	78,245	7.1	
12	12	08	12	7,286	189,610	49,635	6.8	
12	12	08	12	0	0	0	--	Reset totalizer
12	19	08	10	10,078	65,062	65,062	6.5	
12	19	08	10	0	0	0	--	Reset totalizer
01	19	07	16	44,586	301,708	301,708	6.8	
01	30	--	--	--	--	--	--	Decreased to 5 GPM
02	10	08	05	31,729	497,101	195,393	6.2	
Total (14 November)				126,315		759,363	6.0	

Table 5

Trench 2 Recharge 14 November to 10 February

Time				Time Interval	Cumulative Flow	Interval Flow	Average Flow Rate	
Month	Day	Hour	Minute	min	gal	gal	GPM	Remarks
11	14	14	50 (?)	0	6	0	--	Started at 5 GPM
11	16	13	40	2,810	10,780	10,774	3.8	
11	16	15	00	80	11,132	--	--	
11	16	15	00	0	0	0	--	Reset totalizer
11	29	13	50	18,650	50,242	50,242	2.7	
12	07	06	46	11,096	81,730	31,488	2.8	
12	12	08	12	7,286	94,777	13,047	1.8	
12	12	08	12	0	0	0	--	Reset totalizer
12	19	08	10	10,078	16,719	16,719	1.7	
12	19	08	10	0	0	0	--	Reset totalizer
01	13	11	45	36,215	11,468	11,468	0.3	
01	14	15	57	1,692	20,103	8,635	5.1	Stopped flow
01	17	07	05	3,788	20,103	0	0.0	Idle
01	18	08	50	1,545	23,587	3,484	2.3	
01	19	07	16	1,346	23,587	0	0.0	Idle
02	10	08	05	31,729	23,622	35	0.0	
Total (14 November)				126,315		146,250	1.2	

Table 6

Trench 3 Recharge 8 November to 10 February

Time				Time Interval	Cumulative Flow	Interval Flow	Average Flow Rate	
Month	Day	Hour	Minute	min	gal	gal	GPM	Remarks
11	08	14	30	0	0	0	--	Started at 10 GPM
11	09	15	00	1,470	11,300	11,300	7.7	Reduced to 5 GPM
11	11	09	00	2,520	23,085	11,785	4.7	
11	16	13	40	7,480	52,720	29,635	4.0	
11	16	15	00	80	53,040	--	--	
11	16	15	00	0	0	0	--	Reset totalizer
11	29	13	50	18,650	42,759	42,759	2.3	
12	01	13	40	--	--	--	--	Reduced to 2 GPM
12	07	06	46	11,096	70,258	27,499	2.5	
12	12	08	12	7,286	86,089	15,831	2.2	
12	12	08	12	0	0	0	--	Reset totalizer
12	19	08	10	10,078	17,591	17,591	0.6	Low-flow interval
12	19	08	10	0	0	0	--	Reset totalizer
01	19	07	16	44,586	90,350	90,350	2.0	
02	10	08	05	31,729	137,116	46,766	1.5	
Total (8 November)				134,975		293,836	2.2	

Table 7

Trench 4 Recharge 1 November to 10 February

Time				Time Interval min	Cumulative Flow gal	Interval Flow gal	Average Flow Rate GPM	Remarks
Month	Day	Hour	Minute					
11	01	12	47	0	0	0	--	Started at 10 GPM
11	01	16	50	243	1,805	1,805	7.4	
11	02	16	05	1,395	15,290	13,485	9.7	
11	03	15	55	1,430	28,500	13,210	9.2	
11	07	12	05	5,530	79,120	50,620	9.2	
11	10	09	00	4,135	121,080	41,960	10.1	
11	16	13	40	8,920	207,450	86,370	9.7	
11	16	15	00	80	208,225	--	--	
11	16	15	00	0	0	0	--	Reset totalizer
11	29	13	50	18,650	165,133	165,133	8.9	
12	07	06	46	11,096	272,130	106,997	9.6	
12	12	08	12	7,286	331,923	59,793	8.2	
12	12	08	12	0	0	0	--	Reset totalizer
12	19	08	10	10,078	74,666	74,666	7.4	
12	19	08	10	0	0	0	--	Reset totalizer
01	12	--	--	--	--	--	--	Meter out
01	19	07	16	44,586	257,069	257,069	5.8	
02	10	08	05	31,729	536,753	279,684	8.8	
Total (1 November)				145,158		1,151,567	7.9	

Table 8

Trench 5 Recharge 2 November to 10 February

Time				Time Interval min	Cumulative Flow gal	Interval Flow gal	Average Flow Rate GPM	Remarks
Month	Day	Hour	Minute					
11	02	11	30	0	0	0	--	Started at 10 GPM
11	02	16	05	275	2,425	2,425	8.8	
11	03	15	55	1,430	14,900	12,475	8.7	
11	04	16	00	1,445	26,975	12,075	8.4	
11	07	12	05	4,085	62,340	35,365	8.7	
11	10	09	00	4,135	100,850	38,510	9.3	
11	16	13	40	8,920	178,310	77,460	8.7	
11	16	15	00	80	179,005	--	--	
11	16	15	00	0	0	0	--	Reset totalizer
11	29	13	50	18,650	131,159	131,159	7.0	
12	01	13	40	--	--	--	--	Increased to 10 GPM
12	07	06	46	11,096	223,640	92,481	8.3	
12	12	08	12	7,286	291,542	67,902	9.3	
12	12	08	12	0	0	0	--	Reset totalizer
12	19	08	10	10,078	100,455	100,455	10.0	
12	19	08	10	0	0	0	--	Reset totalizer
01	19	07	16	44,586	435,140	435,140	9.8	
02	10	08	05	31,729	752,268	317,128	10.0	
Total (2 November)				143,795		1,323,270	9.2	

Table 9

Trench 6 Recharge 3 November to 10 February

Time				Time Interval	Cumulative Flow	Interval Flow	Average Flow Rate	
Month	Day	Hour	Minute	min	gal	gal	GPM	Remarks
11	03	13	40	0	0	0	--	Started at 10 GPM
11	03	15	55	135	1,075	1,075	8.0	
11	04	08	20	985	8,940	7,865	8.0	
11	07	12	05	4,545	45,700	36,760	8.1	
11	07	12	05	--	--	--	--	Increased to 15 GPM
11	10	09	00	4,135	107,190	61,490	14.9	
11	16	13	40	8,920	232,500	125,310	14.0	
11	16	15	00	80	233,624	--	--	
11	16	15	00	0	0	0	--	Reset totalizer
11	29	13	50	18,650	312,113	312,113	16.7	
12	07	06	46	11,096	510,360	198,247	17.9	
12	12	08	12	7,286	620,664	110,304	15.1	
12	12	08	12	0	0	0	--	Reset totalizer
12	19	08	10	10,078	136,730	136,730	13.6	Low-flow interval
12	19	08	10	0	0	0	--	Reset totalizer
01	19	07	16	44,586	678,815	678,815	15.2	
02	10	08	05	31,729	1,227,689	548,874	17.3	
Total (3 November)				142,225		2,218,707	15.6	

Table 10

Trench 7 Recharge 3 November to 10 February

Time				Time Interval min	Cumulative Flow gal	Interval Flow gal	Average Flow Rate GPM	Remarks
Month	Day	Hour	Minute					
11	03	13	30	0	0	0	--	Started at 10 GPM
11	03	15	55	145	1,100	1,100	7.6	
11	04	08	20	985	9,250	8,150	8.3	
11	07	13	40	4,640	48,850	39,600	8.5	
11	07	13	40	--	--	--	--	Increased to 25 GPM
11	08	14	00	--	--	--	--	Increased to 30 GPM
11	10	09	00	4,040	161,170	112,320	27.8	
11	16	13	40	8,920	430,190	269,020	30.2	
--	--	--	--	--	--	--	--	Increased to 40 GPM
11	16	15	00	80	433,067	--	--	
11	16	15	00	0	0	0	--	Reset totalizer
11	29	13	50	18,650	739,580	739,580	39.7	
12	07	06	46	11,096	1,211,780	472,200	42.6	
12	12	08	12	7,286	1,472,023	260,243	35.7	
12	12	08	12	0	0	0	--	Reset totalizer
12	19	08	10	10,078	319,583	319,583	31.7	Low-flow interval
12	19	08	10	0	0	0	--	Reset totalizer
01	19	07	16	44,586	1,679,970	1,679,970	37.7	
02	10	08	05	31,729	3,084,402	1,404,432	44.3	
Total (3 November)				142,235		5,309,075	37.3	

Table 11

Trench 8 Recharge 31 October to 10 February

Time				Time Interval min	Cumulative Flow gal	Interval Flow gal	Average Flow Rate GPM	Remarks
Month	Day	Hour	Minute					
10	31	08	55	0	0	0	--	Started at 10 GPM
11	01	10	30	1,535	16,237	--	10.6	
11	01	10	30	--	--	--	--	Shut down 103 min
11	01	12	13	--	--	--	--	Restarted at 22 GPM
11	02	11	10	1,377	46,666	30,429	22.1	
11	02	11	55	--	--	--	--	Increased to 30 GPM
11	02	12	26	76	48,760	2,094	27.6	
11	04	16	00	3,094	135,200	86,440	27.9	
11	07	12	05	4,085	252,300	117,100	28.7	
11	09	09	15	2,710	338,450	86,150	31.8	
11	16	13	40	10,345	684,500	346,050	33.4	
--	--	--	--	--	--	--	--	Increased to 40 GPM
11	16	15	00	80	687,610	--	--	
11	16	15	00	0	0	0	--	Reset totalizer
11	29	13	50	18,650	756,877	756,877	40.6	
12	07	06	46	11,096	1,235,800	478,973	43.2	
12	12	08	12	7,286	1,507,704	271,904	37.3	
12	12	08	12	0	0	0	--	Reset totalizer
12	19	08	10	10,078	334,475	334,475	33.2	Low-flow interval
12	19	08	10	0	0	0	--	Reset totalizer
01	19	07	16	44,586	1,747,470	1,747,470	39.2	
01	30	--	--	--	--	--	--	Decreased to 35 GPM
02	10	08	05	31,729	3,052,753	1,305,283	41.1	
Total (31 October)				146,830		5,582,542	38.0	

Table 12

Trench 9 Recharge 7 November to 10 February

Time				Time Interval min	Cumulative Flow gal	Interval Flow gal	Average Flow Rate GPM	Remarks
Month	Day	Hour	Minute					
11	07	13	50	0	94	0	--	Started at 10 GPM
11	07	16	05	135	1,540	1,540	11.4	
11	08	11	40	1,175	13,170	11,630	9.9	
11	08	14	00	--	--	--	--	Increased to 20 GPM
11	09	09	15	1,295	38,390	25,220	19.5	
11	09	14	00	--	--	--	--	Increased to 30 GPM
11	10	09	00	1,425	77,760	38,870	27.3	
11	16	13	40	8,920	324,500	246,740	27.7	
--	--	--	--	--	--	--	--	Increased to 40 GPM
11	16	15	00	80	367,713	--	--	
11	16	15	00	0	0	0	--	Reset totalizer
11	29	13	50	18,650	747,139	747,139	40.1	
12	07	06	46	11,096	1,224,530	477,391	43.0	
12	12	08	12	7,286	1,483,157	258,627	35.5	
12	12	08	12	0	0	0	--	Reset totalizer
12	19	08	10	10,078	316,466	316,466	31.4	Low-flow interval
12	19	08	10	0	0	0	--	Reset totalizer
01	19	07	16	44,586	1,656,600	1,656,000	37.2	
01	30	--	--	--	--	--	--	Decreased to 25 GPM
02	10	08	05	31,729	2,608,438	951,838	30.0	
Total (7 November)				136,455		4,775,774	35.0	

Table 13

Trench 10 Recharge 7 November to 10 February

Time				Time Interval min	Cumulative Flow gal	Interval Flow gal	Average Flow Rate GPM	Remarks
Month	Day	Hour	Minute					
11	07	14	00	0	48	0	--	Started at 10 GPM
11	07	16	05	125	1,480	1,432	11.5	
11	08	11	40	1,175	12,820	11,340	9.7	
11	08	14	00	--	--	--	--	Increased to 20 GPM
11	09	09	15	1,295	35,950	23,130	17.9	
11	10	09	00	1,425	62,060	26,110	18.3	
11	16	13	40	8,920	212,900	150,840	16.9	
11	16	15	00	80	214,253	--	--	
11	16	15	00	0	0	0	--	Reset totalizer
11	29	13	50	18,650	355,492	355,492	19.1	
12	07	06	46	11,096	583,410	227,918	20.5	
12	12	08	12	7,286	707,185	123,775	17.0	
12	12	08	12	0	0	0	--	Reset totalizer
12	19	08	10	10,078	150,217	150,217	14.9	Low-flow interval
12	19	08	10	0	0	0	--	Reset totalizer
01	19	07	16	44,586	750,920	750,920	16.8	
01	30	--	--	--	--	--	--	Decreased to 15 GPM
02	10	08	05	31,729	1,322,826	571,906	18.0	
Total (7 November)				136,445		2,394,481	17.5	

Table 14

Ten-Trench Recharge* 31 October to 10 February

Time Month	Time Day	Time Hour	Time Minute	Time Interval min	Cumulative Flow gal	Interval Flow gal	Average Flow Rate GPM	Remarks
10	31	08	55	0	0	0	--	Started
11	01	16	53	1,918	19,728	19,728	10.3	
11	02	11	15	1,102	53,657	33,929	30.8	
11	02	16	05	290	67.063	13,406	46.2	
11	03	08	20	975	112,000	44,937	46.1	
11	04	16	00	1,900	218,650	106,650	56.1	
11	07	12	05	4,085	467,000	248,350	60.8	
11	09	15	00	3,055	843,210	376,210	123.1	
11	10	09	00	1,080	1,004,700	161,490	149.6	
11	16	13	40	8,920	2,294,350	1,289,650	144.6	
11	16	15	00	80	2,305,000	--	--	
11	16	15	00	0	0	0	--	Reset totalizer
11	29	13	50	18,650	3,305,978	3,305,973	177.3	
12	07	06	46	11,096	5,458,850	2,152,872	194.0	
12	12	08	12	7,286	6,657,080	1,198,230	164.5	
12	12	08	12	0	0	0	--	Reset totalizer
12	19	08	10	10,078	1,483,470	1,483,470	147.1	Low-flow interval
12	19	08	10	0	0	0	--	Reset totalizer
01	19	07	16	44,586	7,448,100	7,448,100	167.1	
02	10	08	05	31,729	12,948,629	5,500,529	173.4	
Total				146,830		23,394,179	159.3	

* Measured at meter 11.

Table 15

Average Trench Recharge (GPM)

Trench	Start to 10 Feb	29 Nov to 7 Dec	25 Jan* to 1 Mar
1	6.0	7.1	11.479
2	1.2	2.8	0.000
3	2.2	2.5	0.478
4	7.9	9.6	7.982
5	9.2	8.3	9.111
6	15.6	17.9	16.701
7	37.3	42.6	41.643
8	38.0	43.2	34.756
9	35.0	43.0	25.577
10	17.5	20.5	14.914
Total	169.9	197.5	162.641
Total (Meter 11)		194.0	

* Flows from 25 January to 1 March from RIC.

Table 16

Trench Recharge Flow Rate Settings (GPM)

Date	Trench 1	2	3	4	5	6	7	8	9	10
Oct 31	0	0	0	0	0	0	0	10	0	0
Nov 1	"	"	"	10	"	"	"	22	"	"
Nov 2	"	"	"	"	10	"	"	30	"	"
Nov 3	"	"	"	"	"	10	10	"	"	"
Nov 4	"	"	"	"	"	"	"	"	"	"
Nov 5	"	"	"	"	"	"	"	"	"	"
Nov 6	"	"	"	"	"	"	"	"	"	"
Nov 7	"	"	"	"	"	15	25	"	10	10
Nov 8	"	"	10	"	"	"	30	"	20	20
Nov 9	"	"	5	"	"	"	"	35	30	"
Nov 10	"	"	"	"	"	"	"	"	"	"
Nov 11	"	"	"	"	"	"	"	"	"	"
Nov 12	"	"	"	"	"	"	"	"	"	"
Nov 13	"	"	"	"	"	"	"	"	"	"
Nov 14	5	5	"	"	"	"	"	"	"	"
Nov 15	"	"	"	"	"	"	"	"	"	"
Nov 16	7	"	"	"	"	20	40	40	40	"
Nov 17	5	"	"	"	"	"	50	50	50	"
Nov 18	"	"	"	"	"	"	40	40	40	"
Nov 19	"	"	"	"	"	"	"	"	"	"
(Settings remained with only minor changes 19 November to 30 January)										
Jan 29	"	"	"	"	"	"	"	"	"	"
Jan 30	5	"	"	"	"	"	"	35	25	15
Jan 31	"	"	"	"	"	"	"	"	"	"
Feb 1	"	"	"	"	"	"	"	"	"	"

(Settings remained with only minor changes throughout February)

Table 17

Response of Water Level in Trenches to Recharge Rates (GPM)

Trench	Rates Causing Rising Level	Rates Causing Falling Level	Estimated Equil. Flow
1	4.3, 3.7, 3.8, 4.5	2.6, 5.4, 1.5	3.0
2	2.0, 2.9	1.6	1.8
3	2.5, 0.6, 1.7	0.8	0.7
4	2.6	4.7	3.0
5	10.8, 10.1, 10.3	9.5, 7.1	9.8
6	14.3	14.2	14.2
7	41.6, 44.3	39.1, 35.2, 43.8	39.1
8	42.3, 39.0, 41.8	40.3, 37.7, 33.7	39.5
9	39.2, 34.9	31.7	33.5
10	17.2, 15.5, 18.4	16.8, 15.7, 15.8	16.2
Total			160.8

Table 18

Water-Table Trends During Winter Months*

Well No.	Water Level Change (ft) 1986-87	1987-88	1988-89
23120 (Alluvium)	+0.33	+0.30	+0.30
24129 (Alluvium)	+0.71	-0.10	-0.20
24150 (Alluvium)	+0.95	+2.15	-1.50
23144 (Denver)	+0.30	+0.25	+0.30
24130 (Denver)	+0.46	-0.15	-0.35

* Three-month period, last week in October to last week in January.

Table 19

Trench Flow Rates at End of Start-up

Trench Number	Average Flow Rate (GPM) 02/17	02/24	03/03
1	3.7	3.8	2.6
2	0.0	0.0	0.0
3	0.0	0.0	0.6
4	9.2	9.5	8.6
5	10.8	--	9.5
6	20.0	--	18.2
7	48.9	--	43.8
8	37.7	--	33.7
9	28.3	--	25.5
10	15.7	--	14.5
Total:	173.9	--	157.0

Table 20

Trench Recharge Rates and Stabilization of Water Table

Date	Depth to Water Table, ft 23110	23111	Recharge Rate* GPM	Water-Table Trend
12 December	16.62	19.30	158	Up
15-19 January	14.96	17.27	162	Up
17 February	13.38	15.69	170	Up
31 March**	12.27	15.15	128	--
17-19 May**	12.62	16.31	99	Down

* Recharge rate for trenches 4 through 10 only.
** Data collected after start-up period.

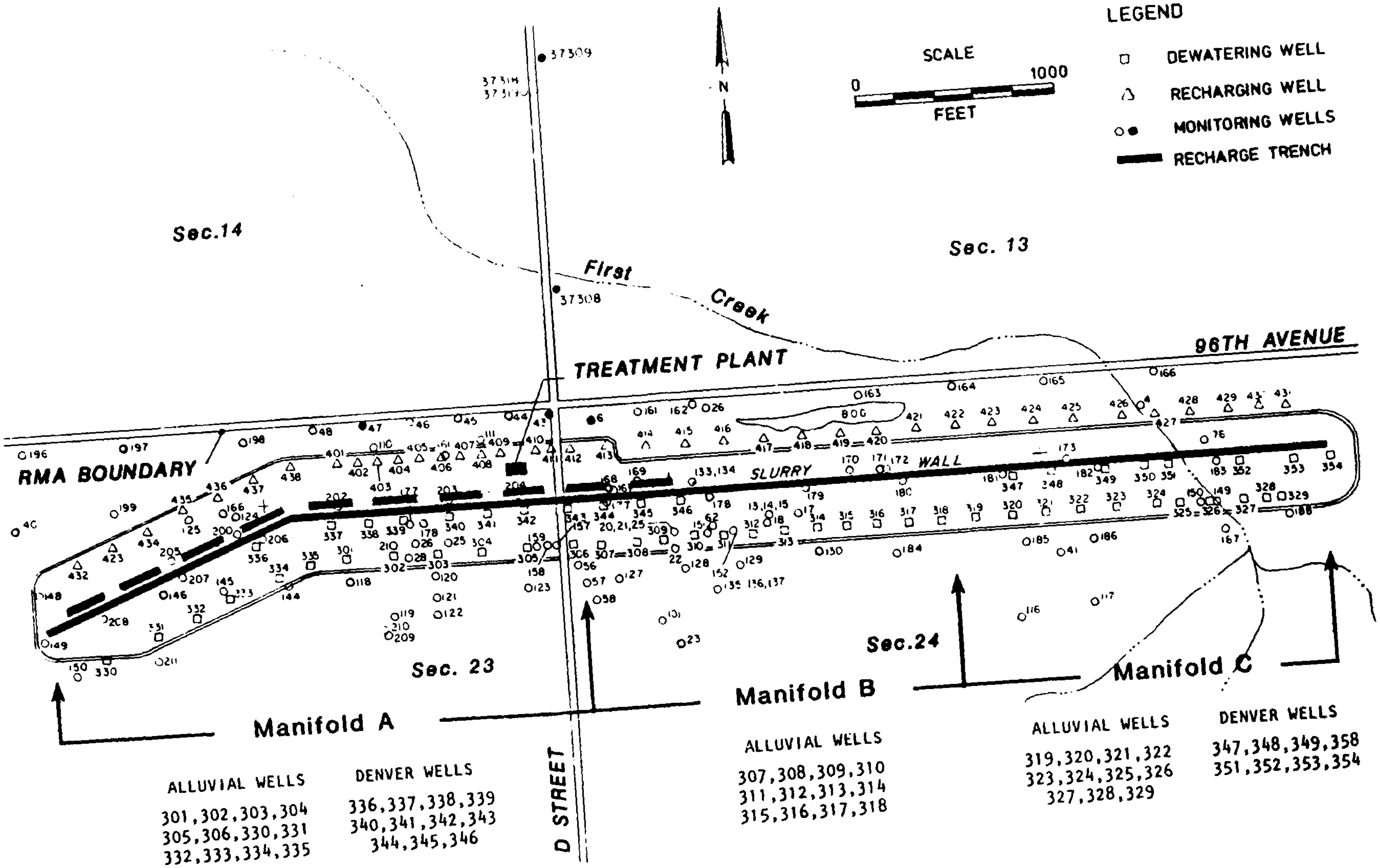


Figure 1. Slurry wall barrier and recharge trench system at North Boundary. Ground water flows northward.

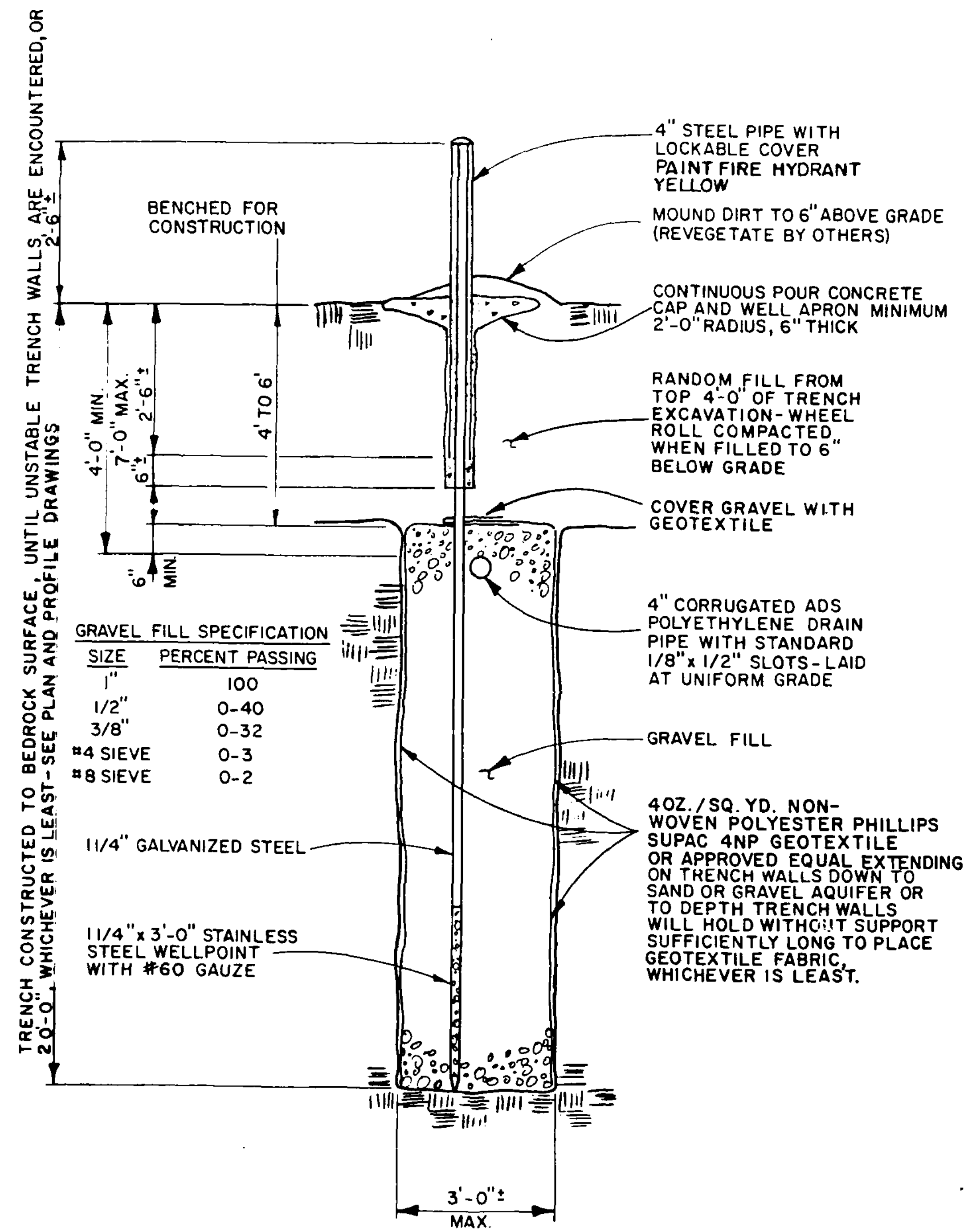


Figure 2. Cross section of typical trench from MKE as-built drawing.

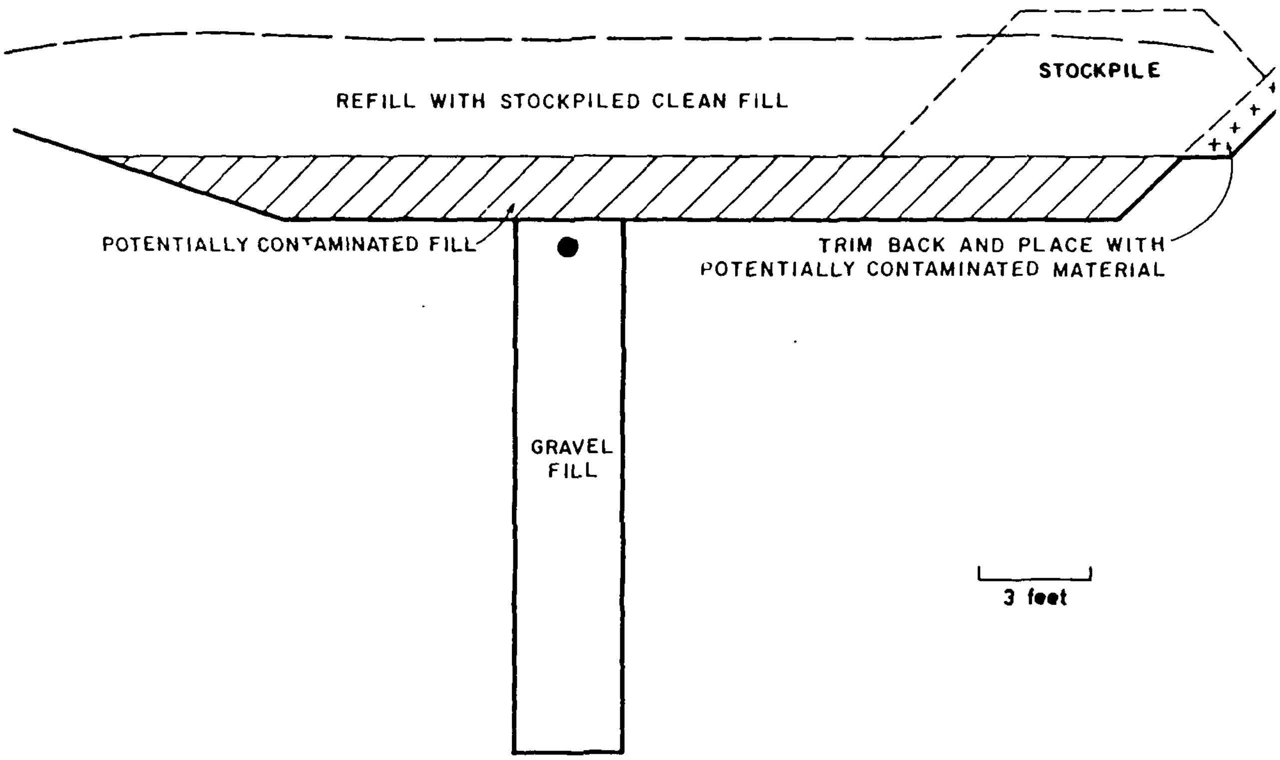


Figure 3. Working bench for burial of soil removed from aquifer (from MKE).

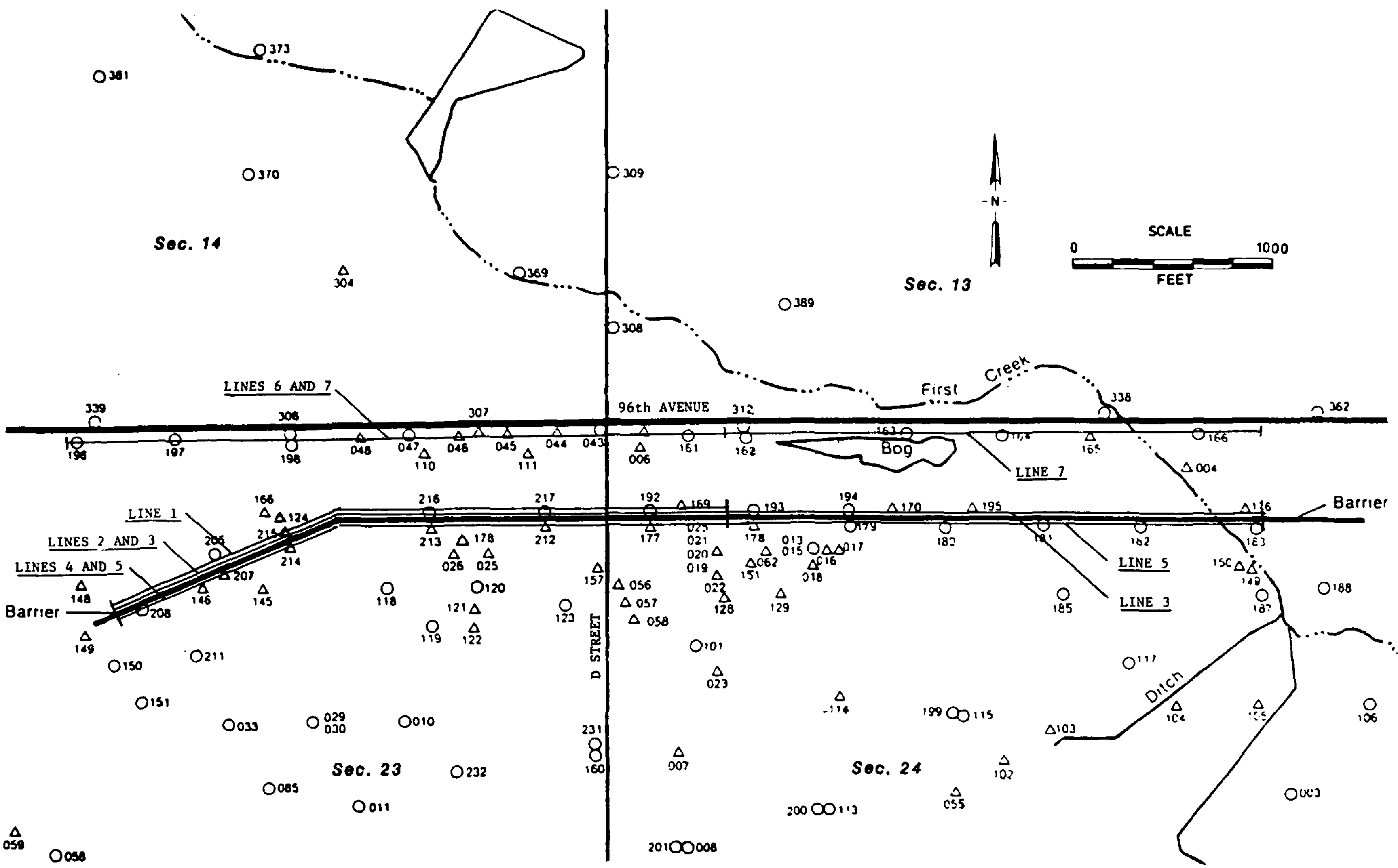


Figure 4. Profile lines of wells and piezometers for monitoring start-up.

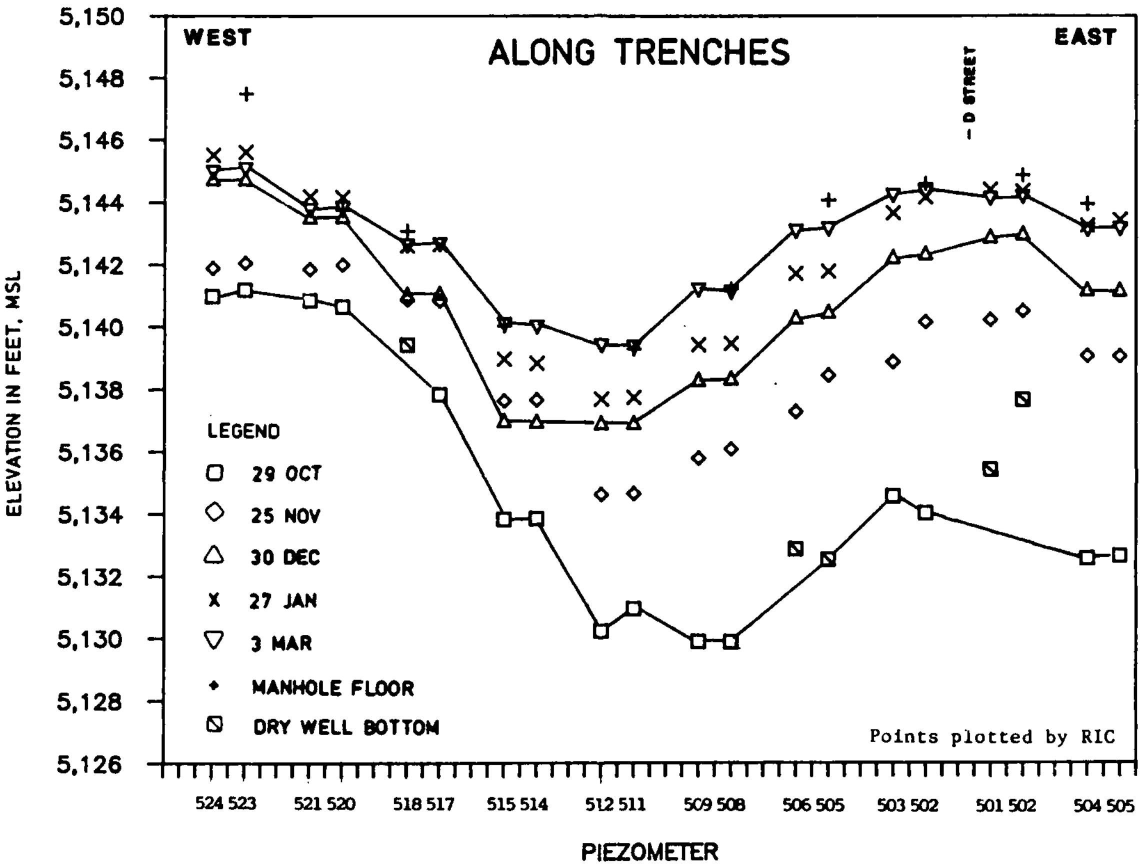


Figure 5. Water-level profile along line 1.

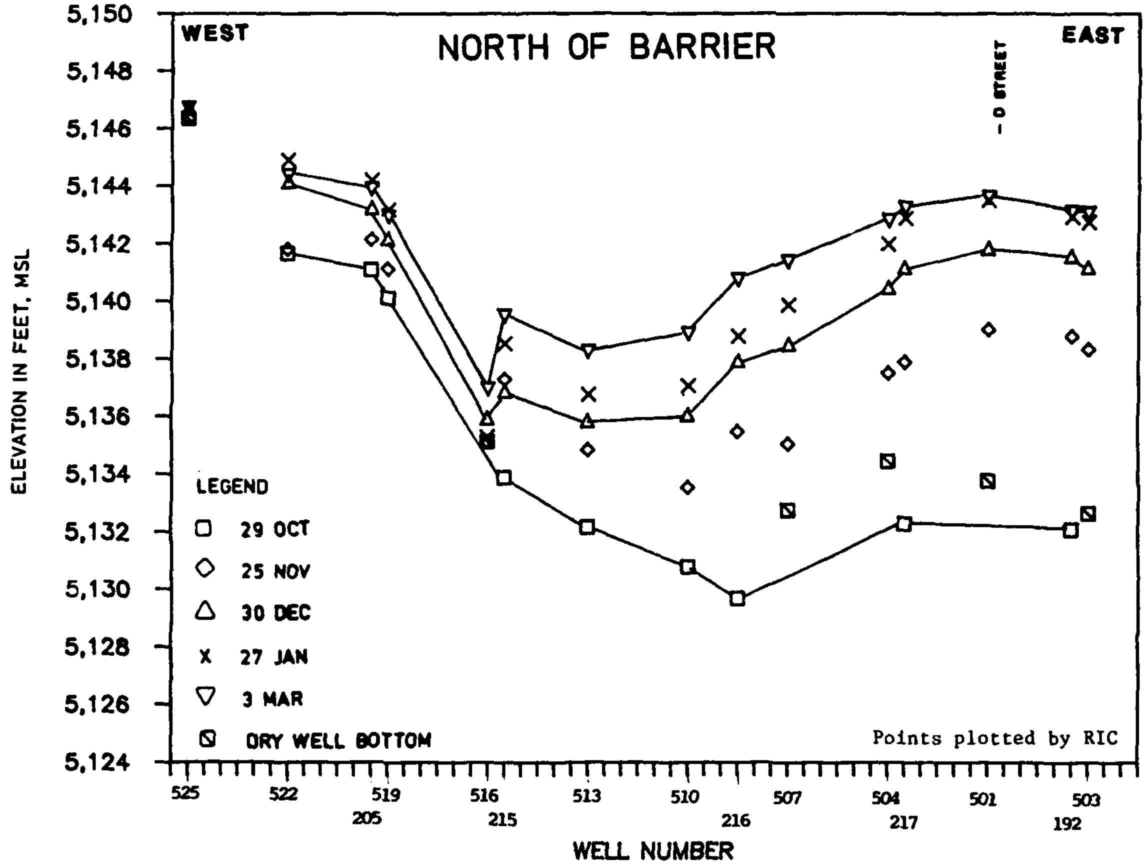


Figure 6. Water-level profile along line 2.

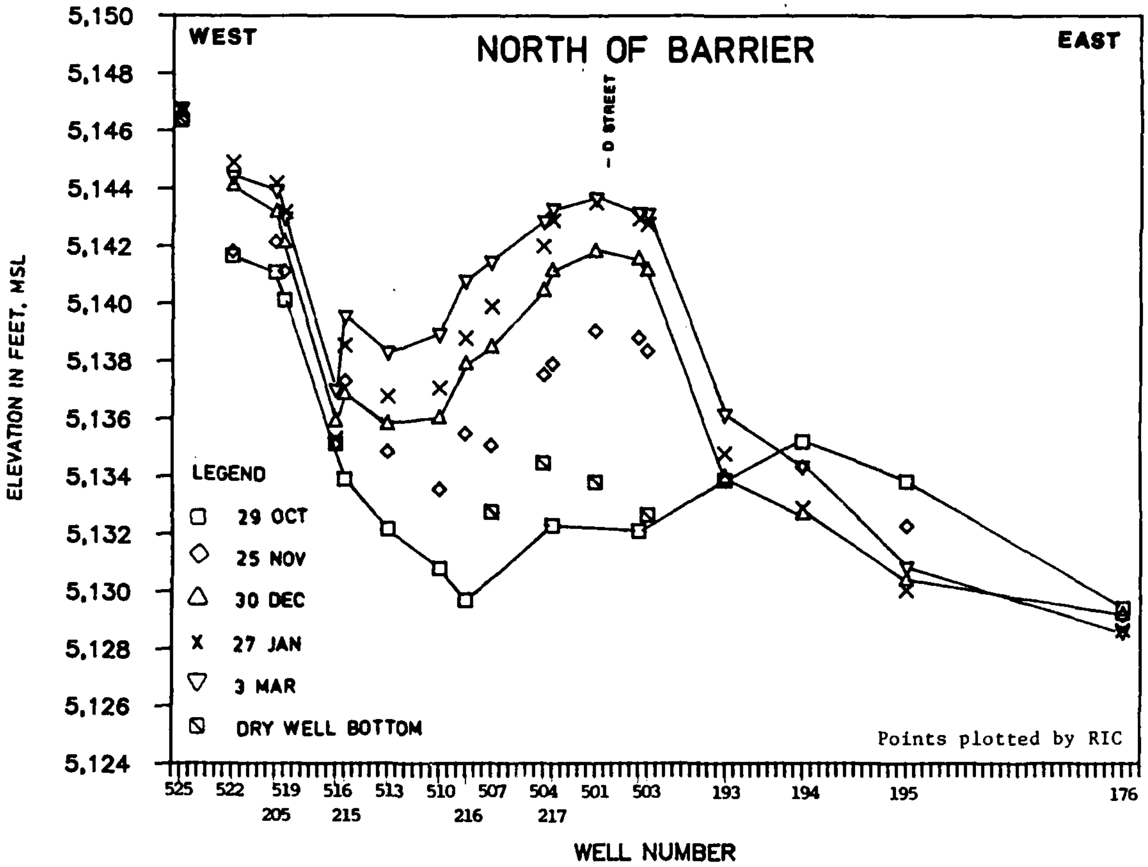


Figure 7. Water-level profile along line 3.

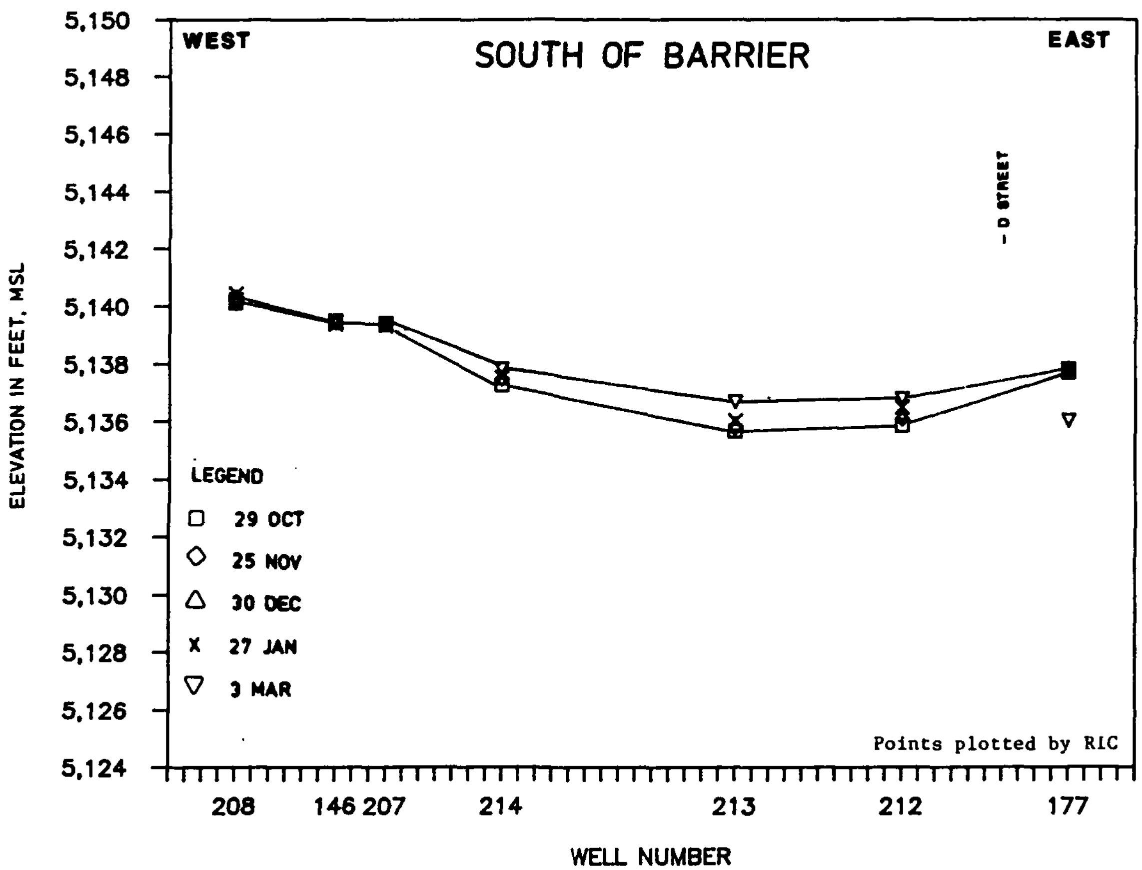


Figure 8. Water-level profile along line 4.

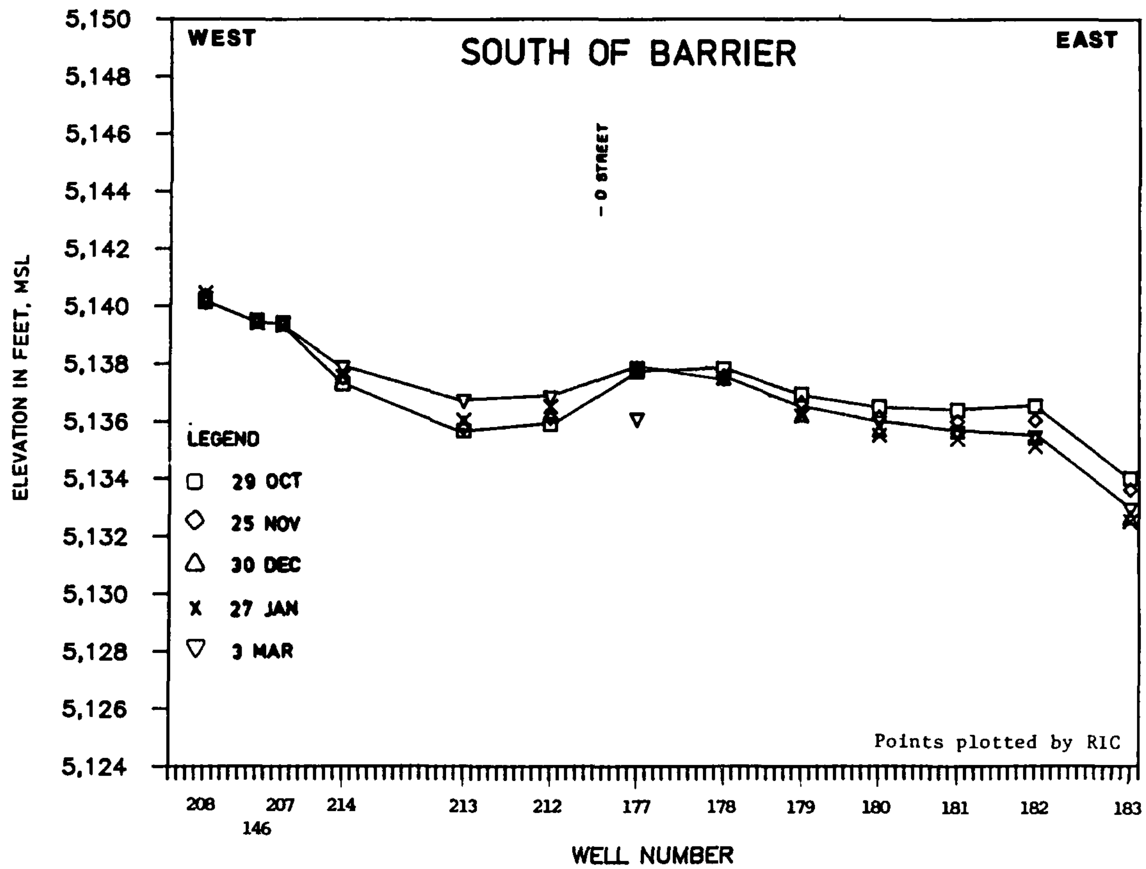


Figure 9. Water-level profile along line 5.

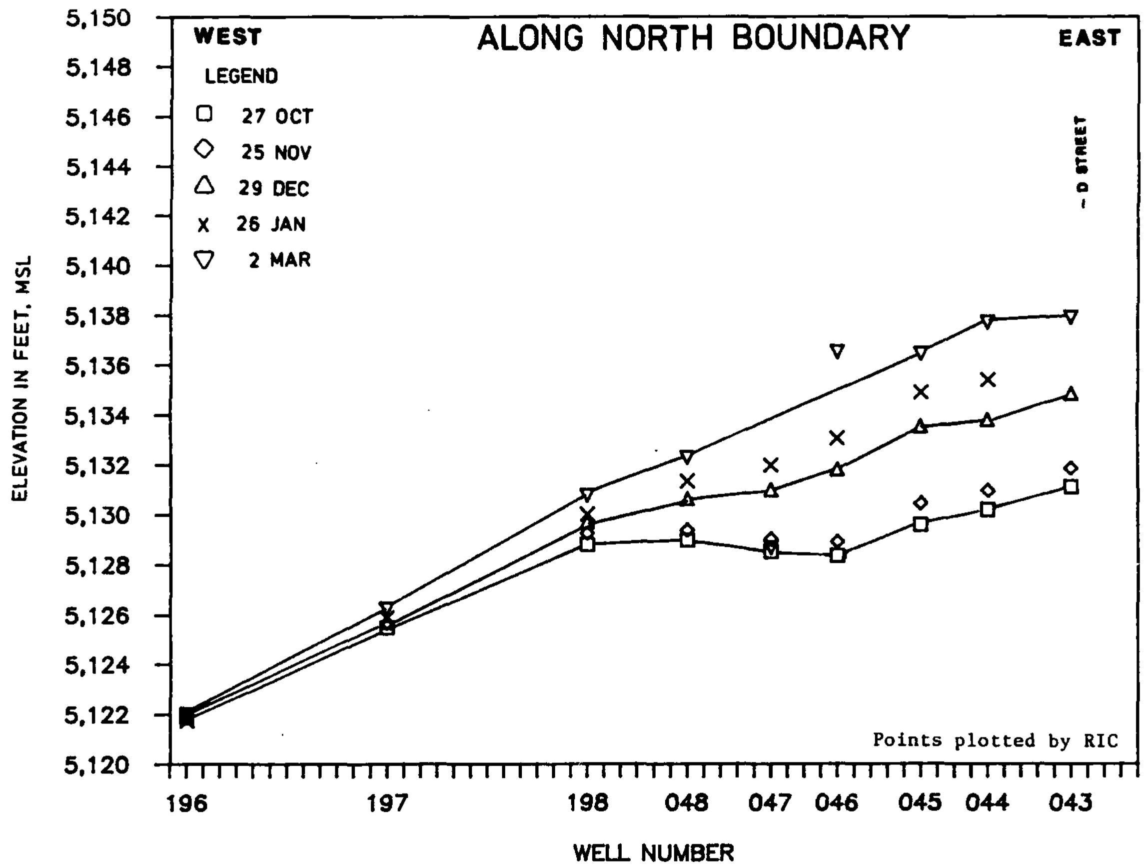


Figure 10. Water-level profile along line 6.

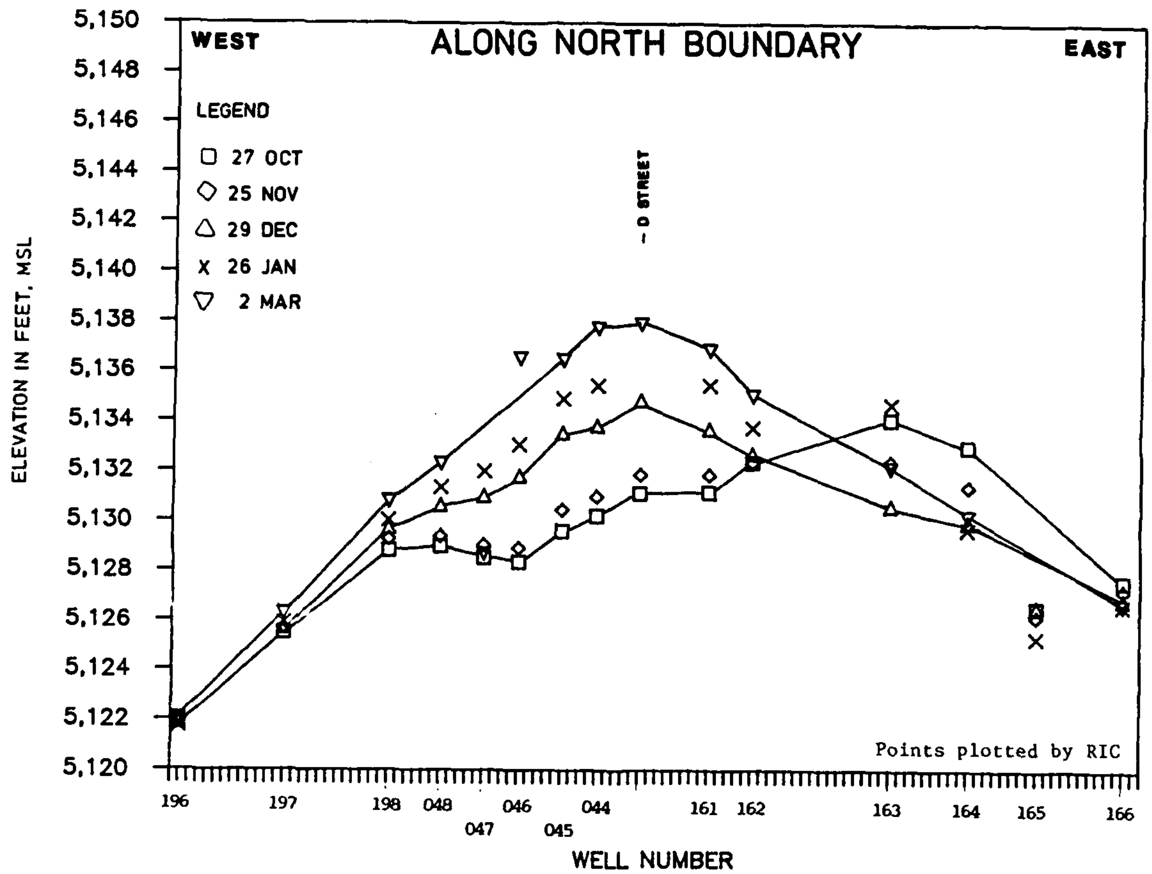


Figure 11. Water-level profile along line 7.

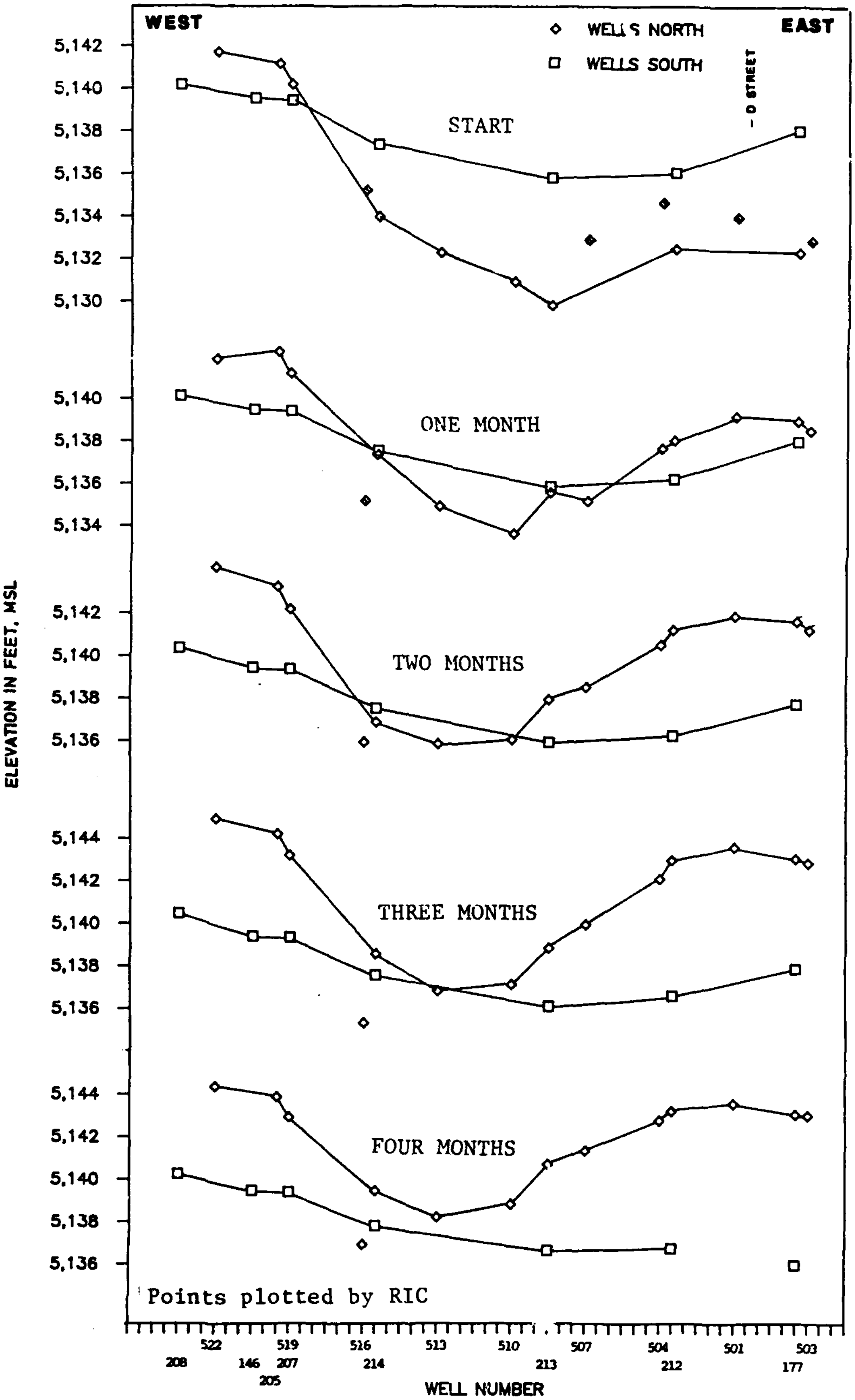


Figure 12. Water-level profiles along lines 2 and 4 compared for five dates during start-up.

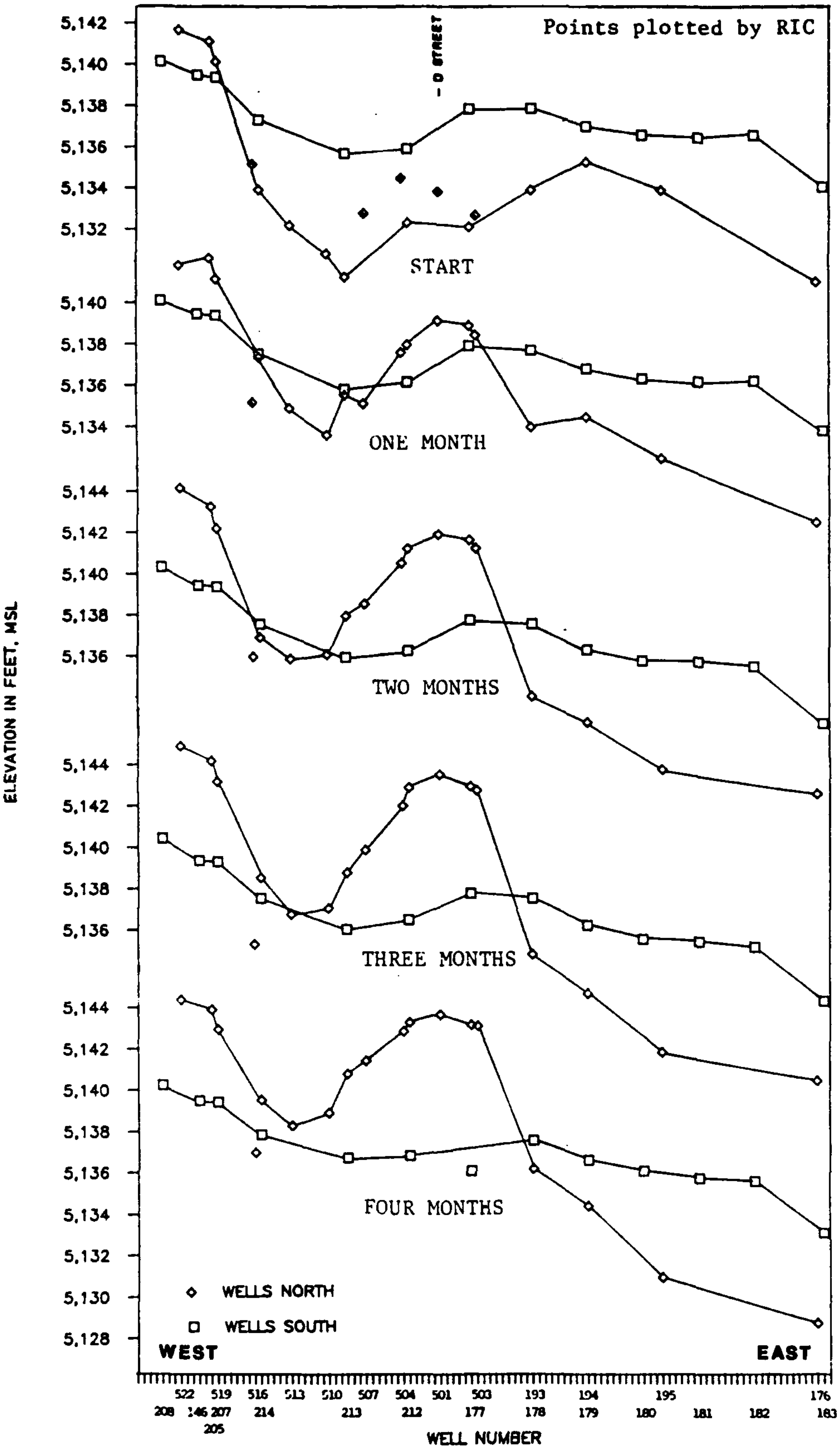


Figure 13. Water-level profiles along lines 3 and 5 compared for five dates during start-up.

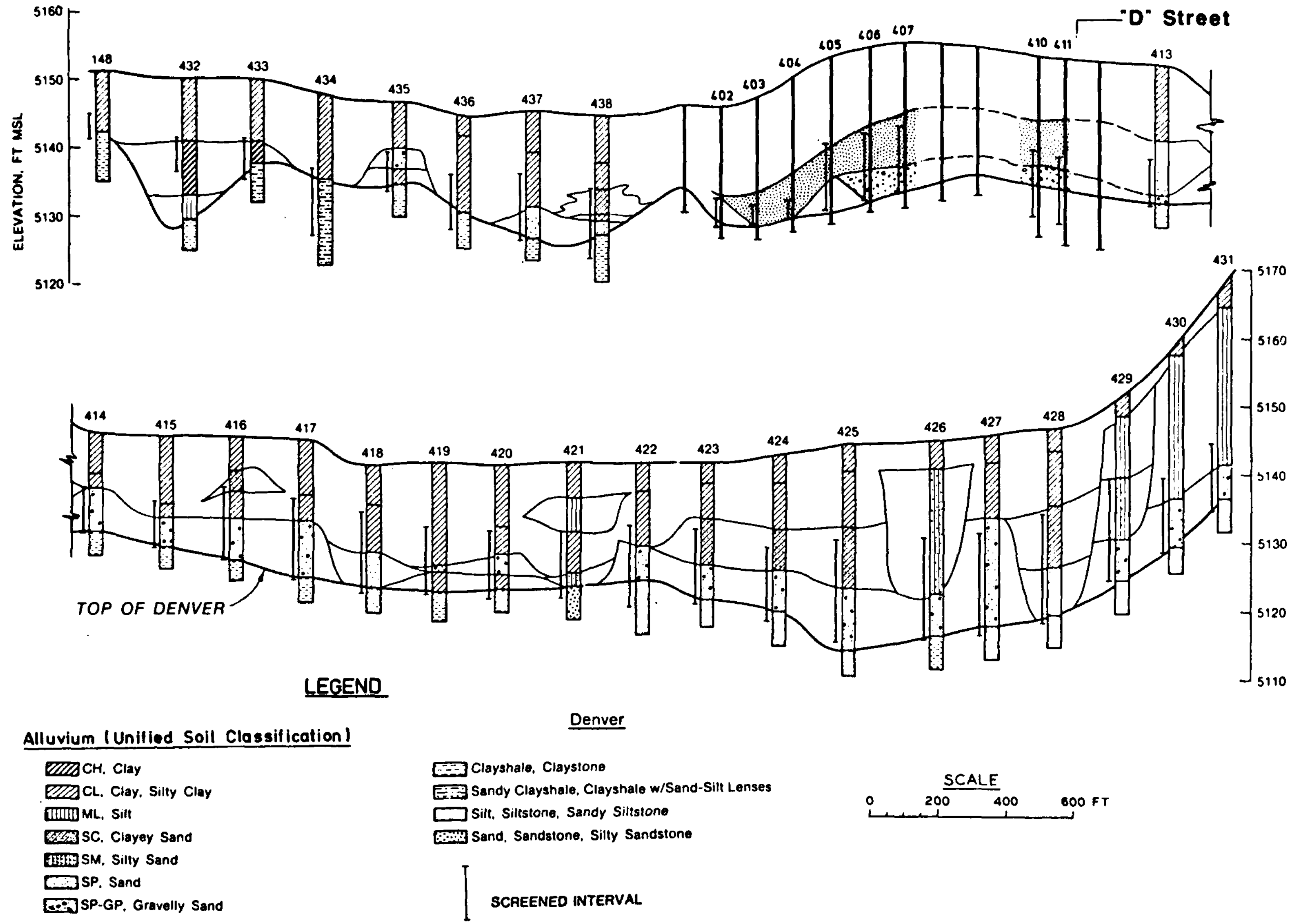


Figure 14. Stratification along recharging-well line.

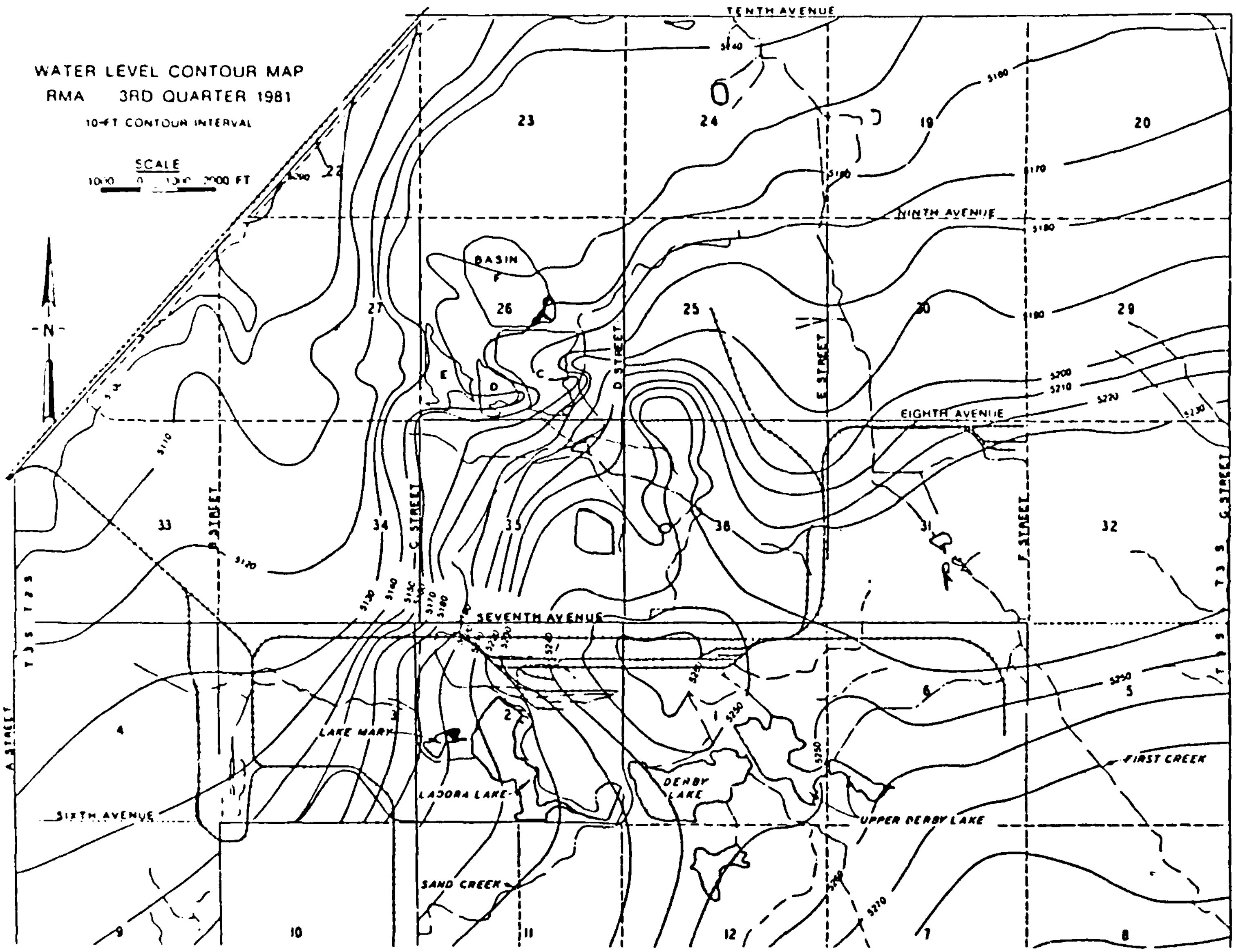


Figure 15. Regional water table.

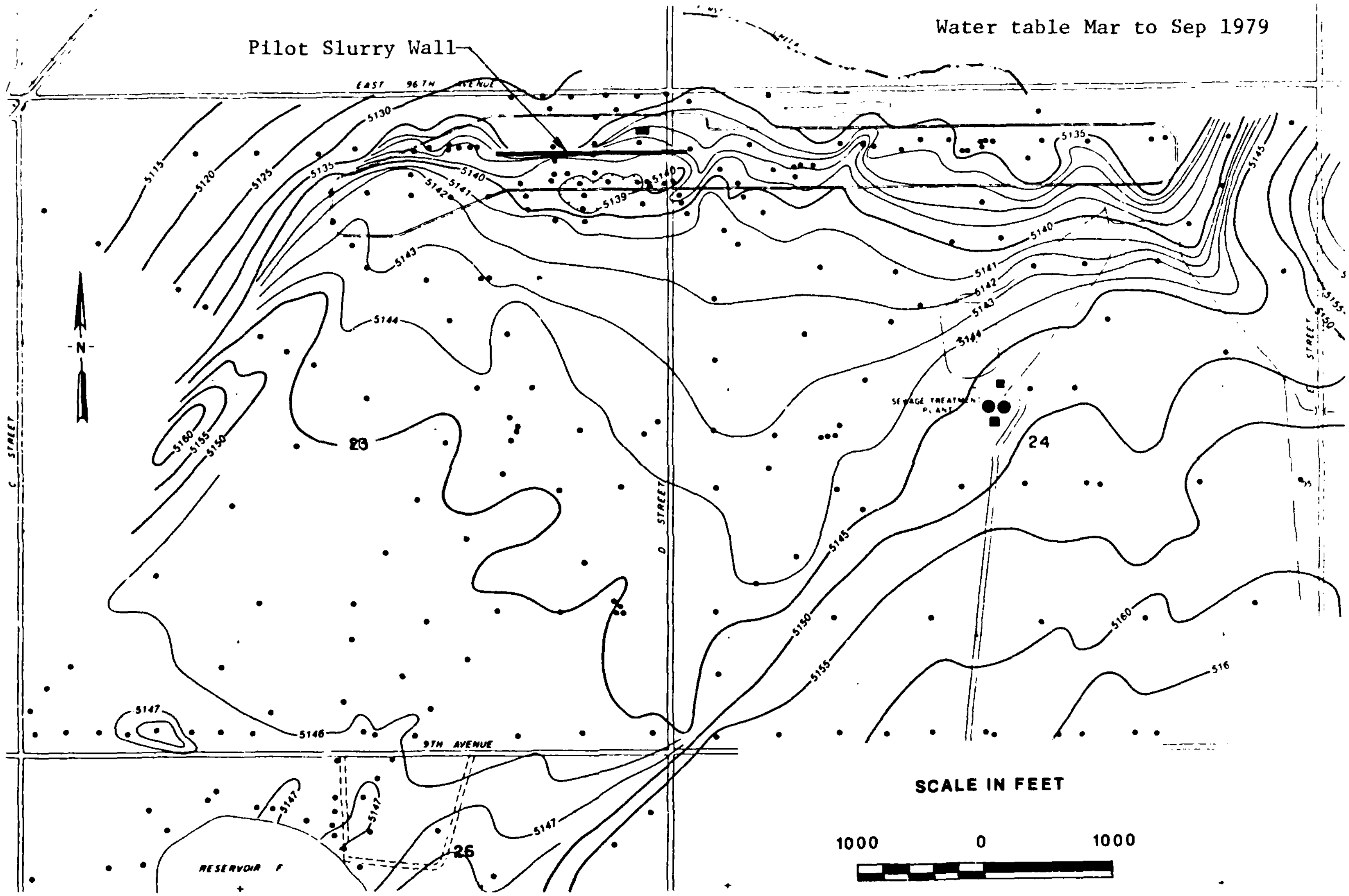


Figure 16. Local water table.

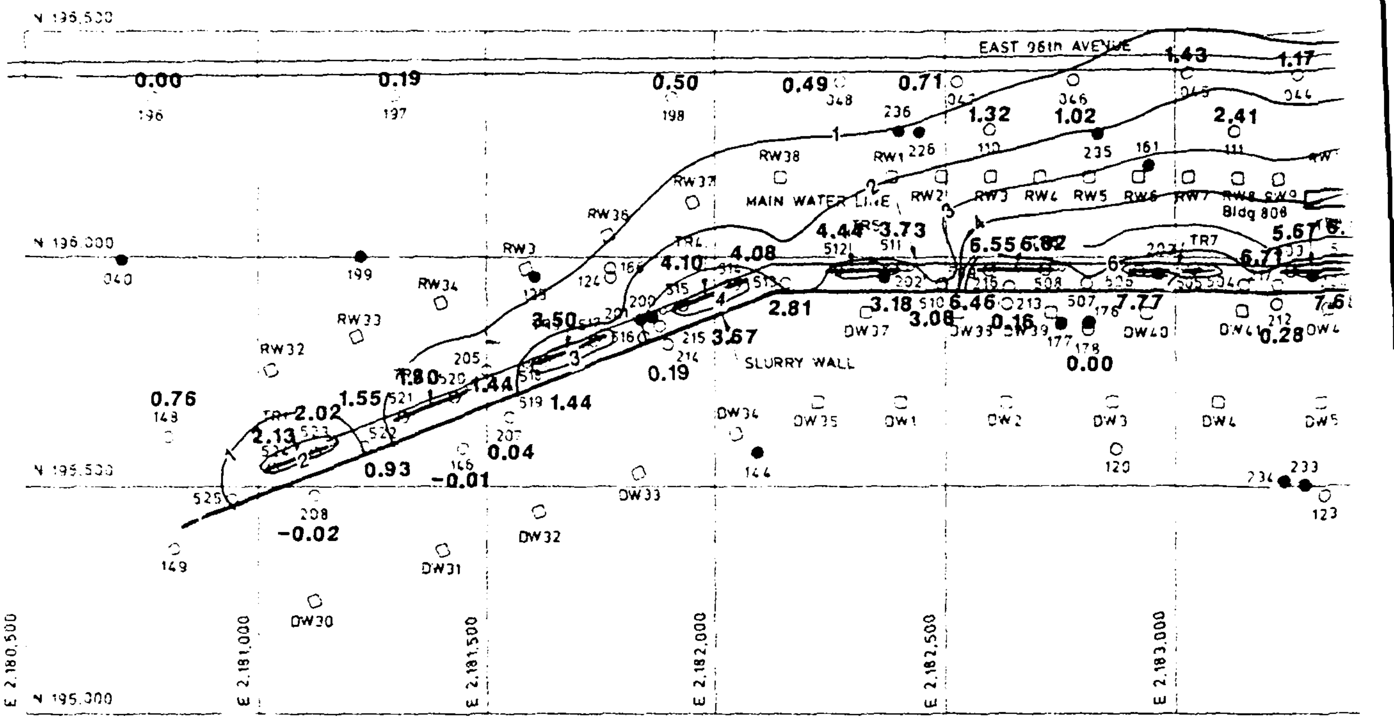


Figure 17. Level changes (ft) in alluvial ground water from 29 Octob

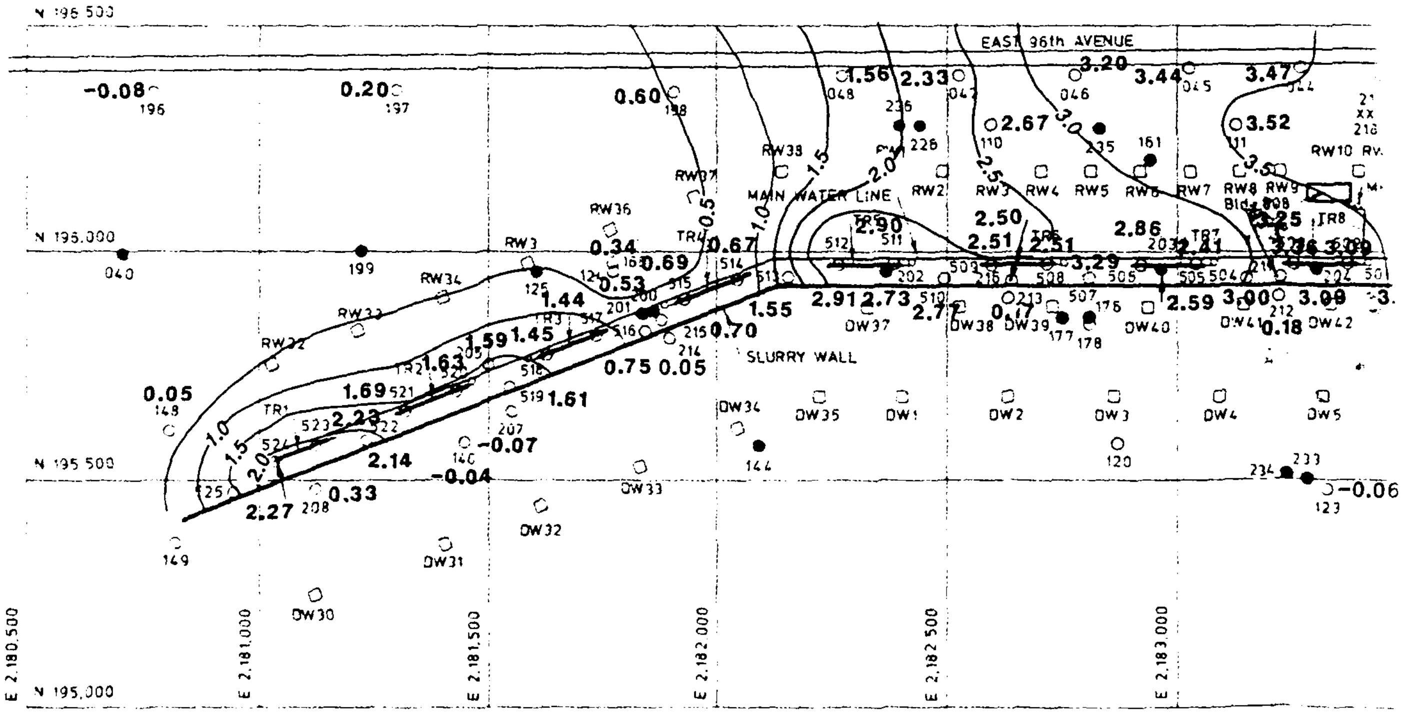
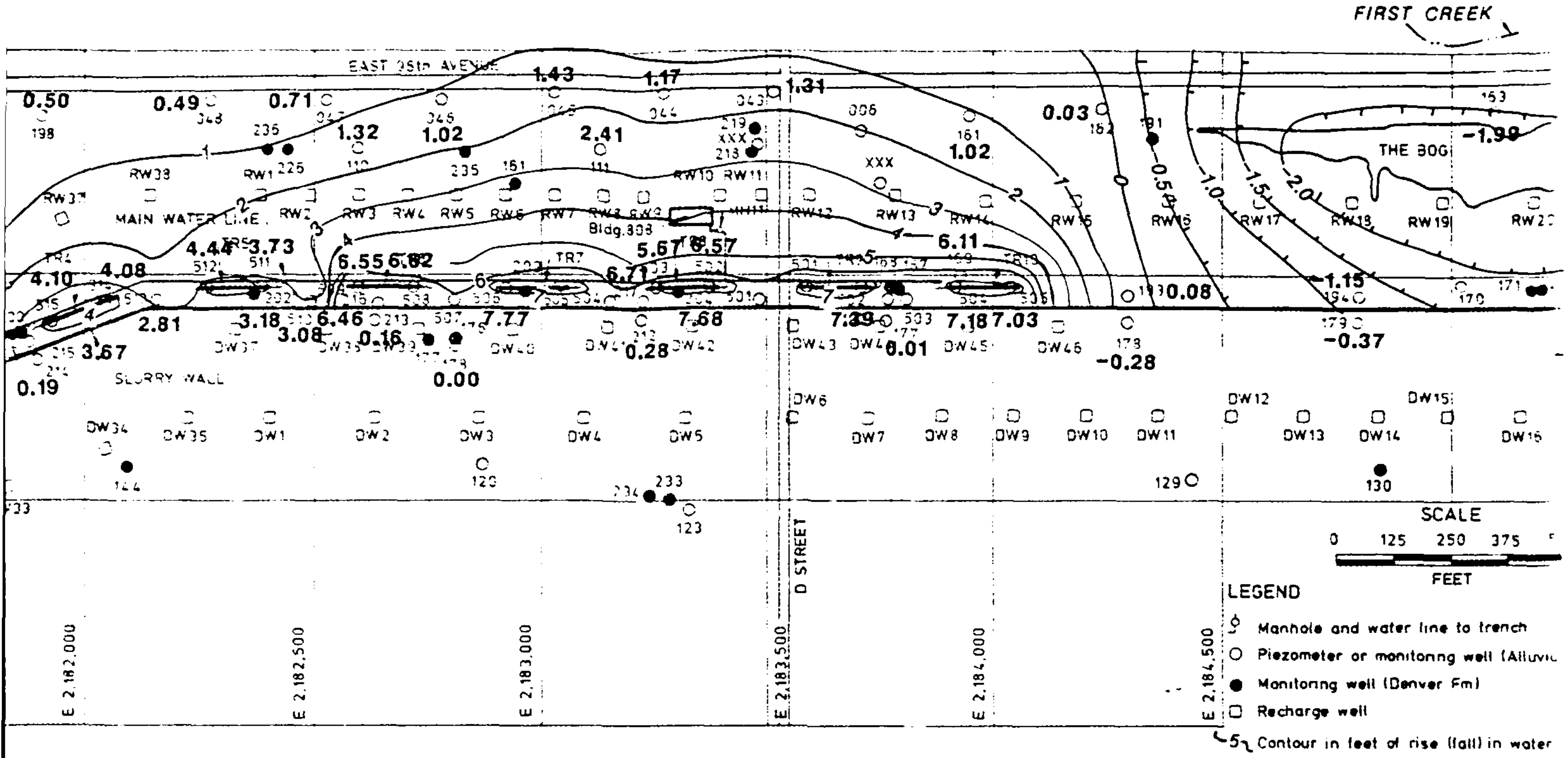
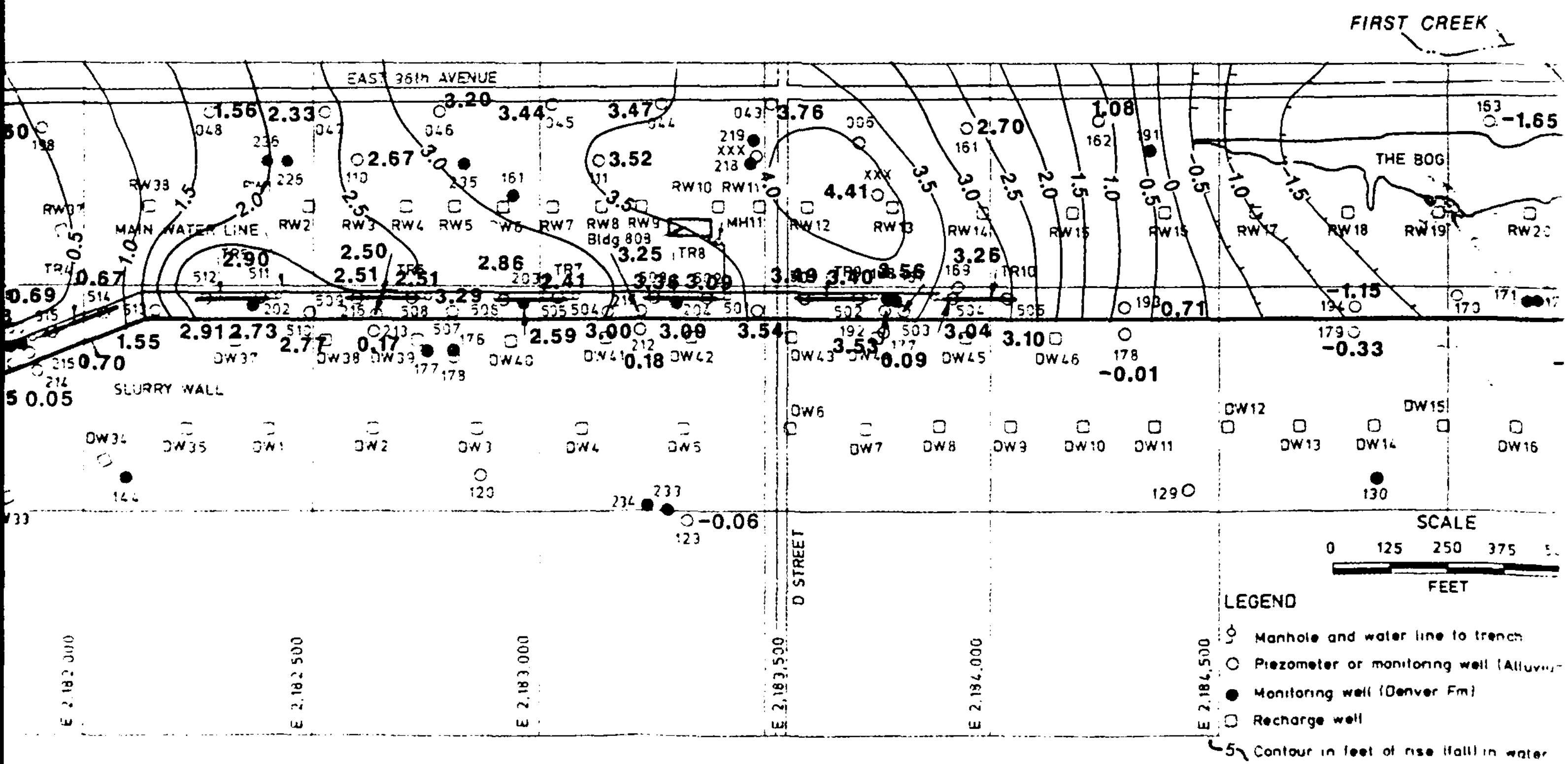


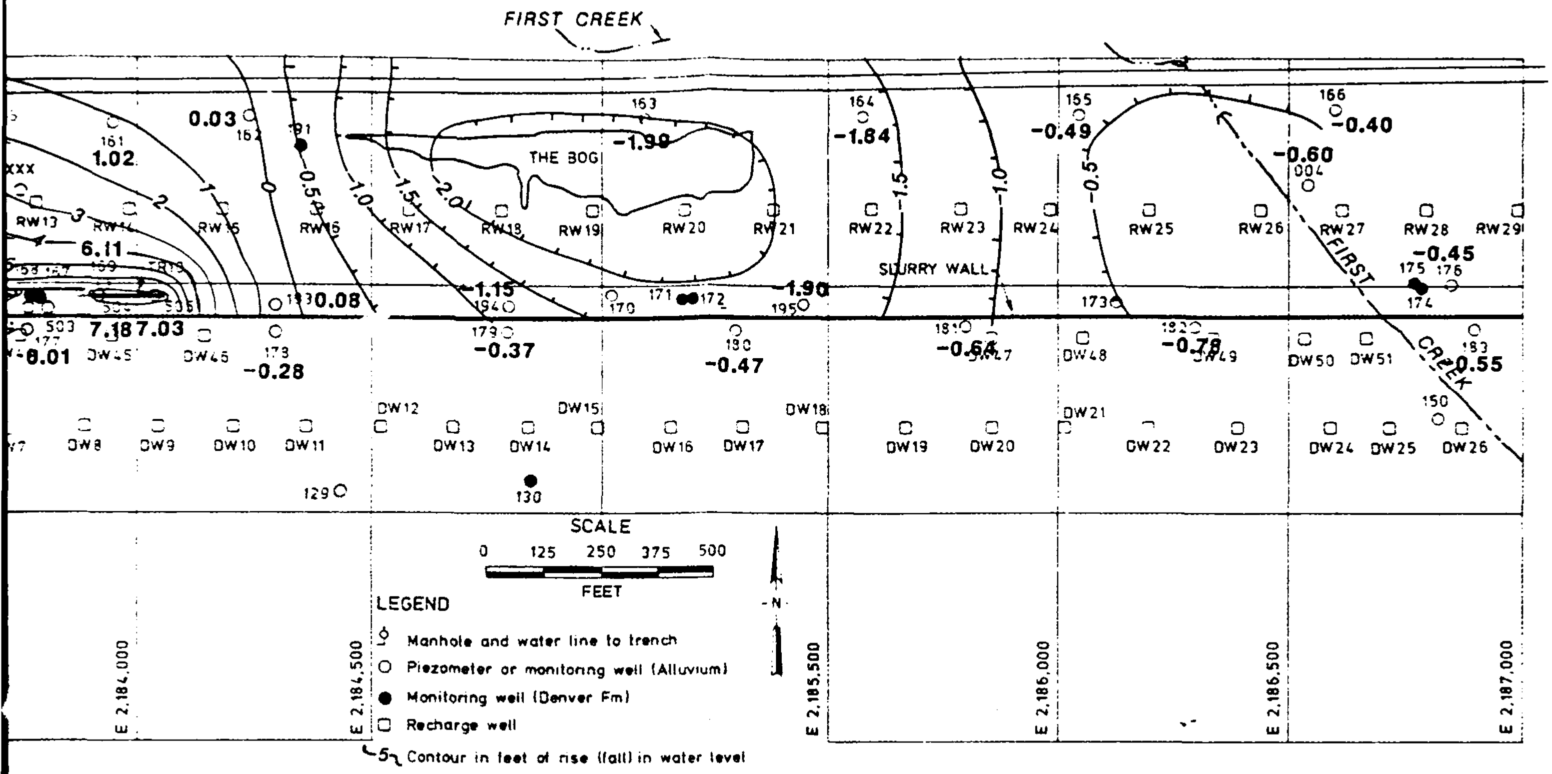
Figure 18. Level changes (ft) in alluvial ground water from 30 Novembe



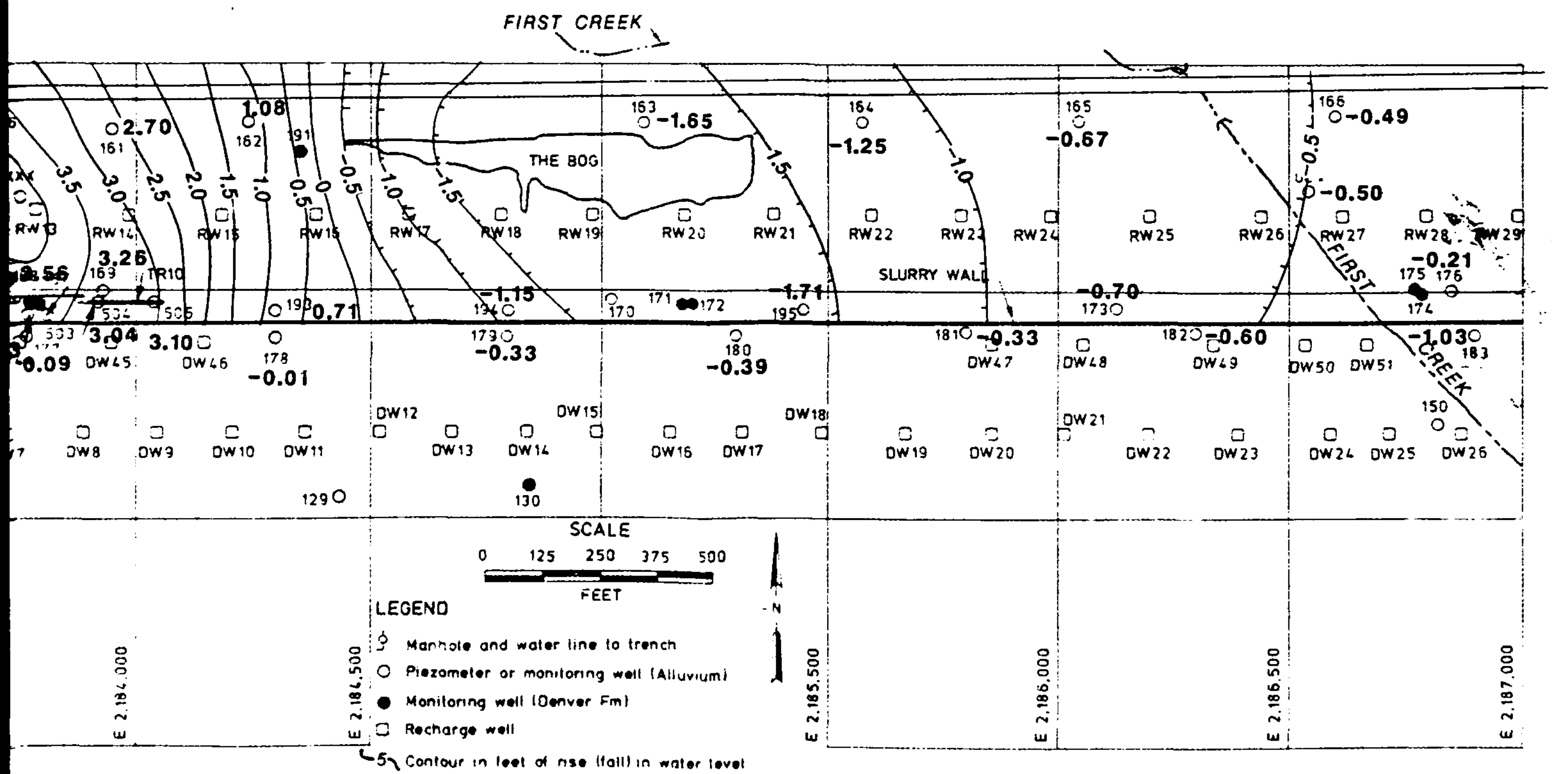
ges (ft) in alluvial ground water from 29 October to 30 November.



ges (ft) in alluvial ground water from 30 November to 15 January.



November.



5 January.

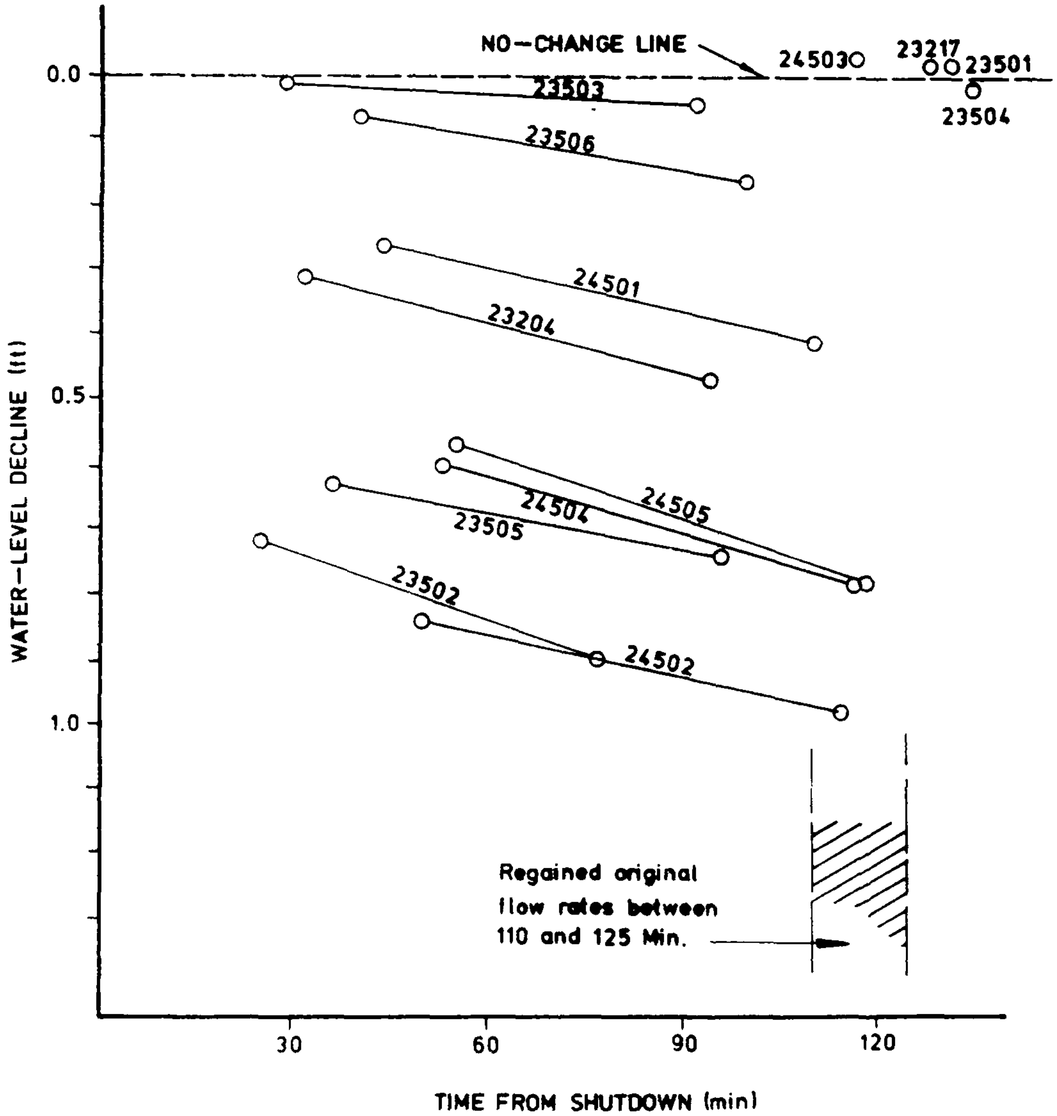


Figure 19. Water-level changes during 2-hour interruption of recharging.

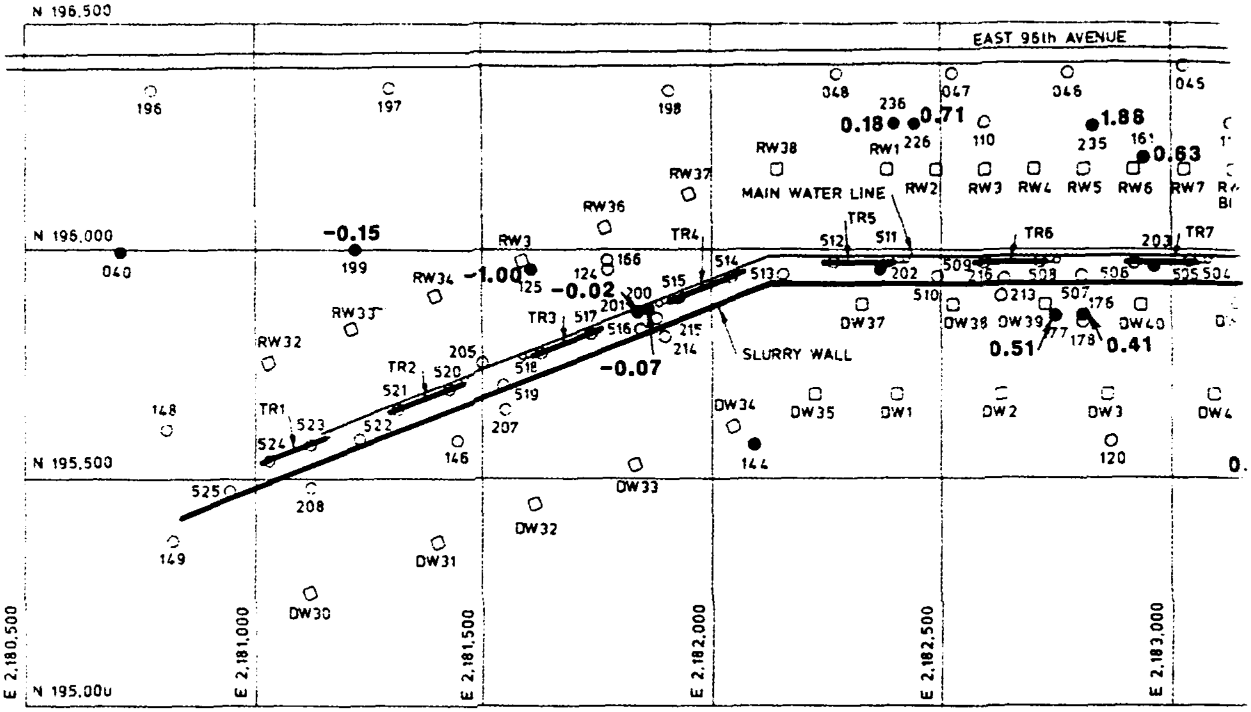


Figure 20. Level changes (ft) in Denver formation ground wat

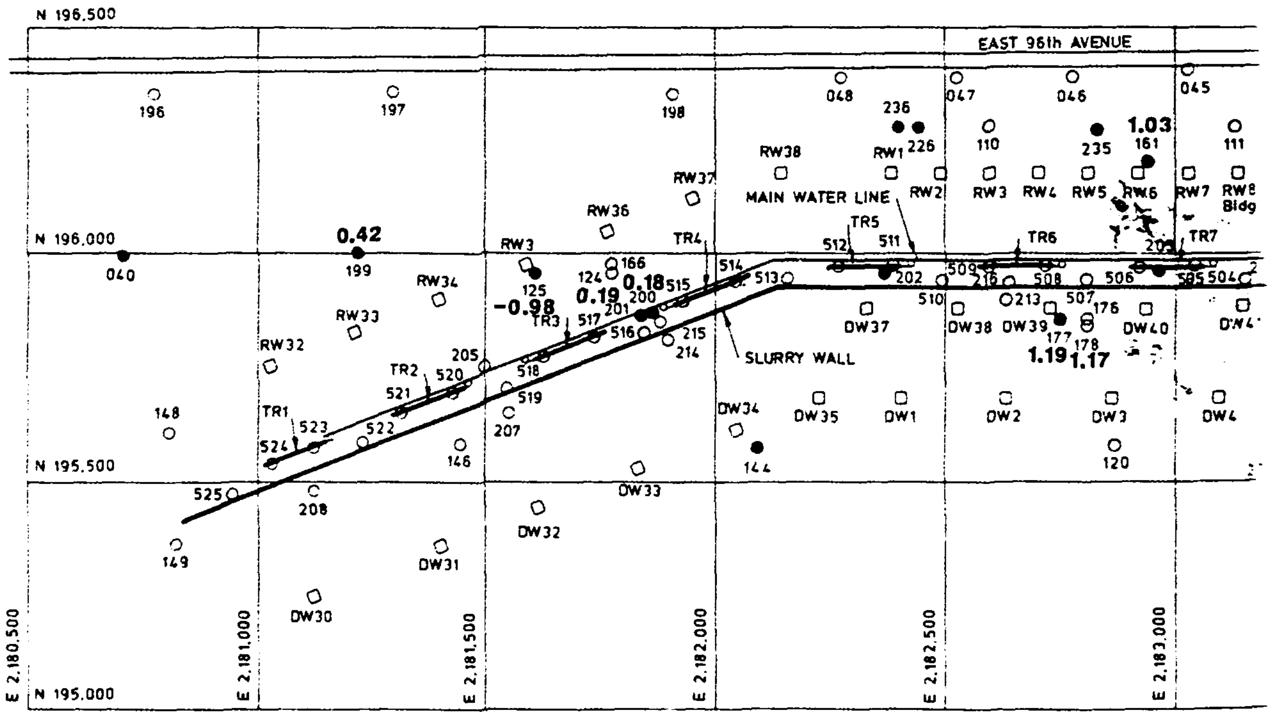
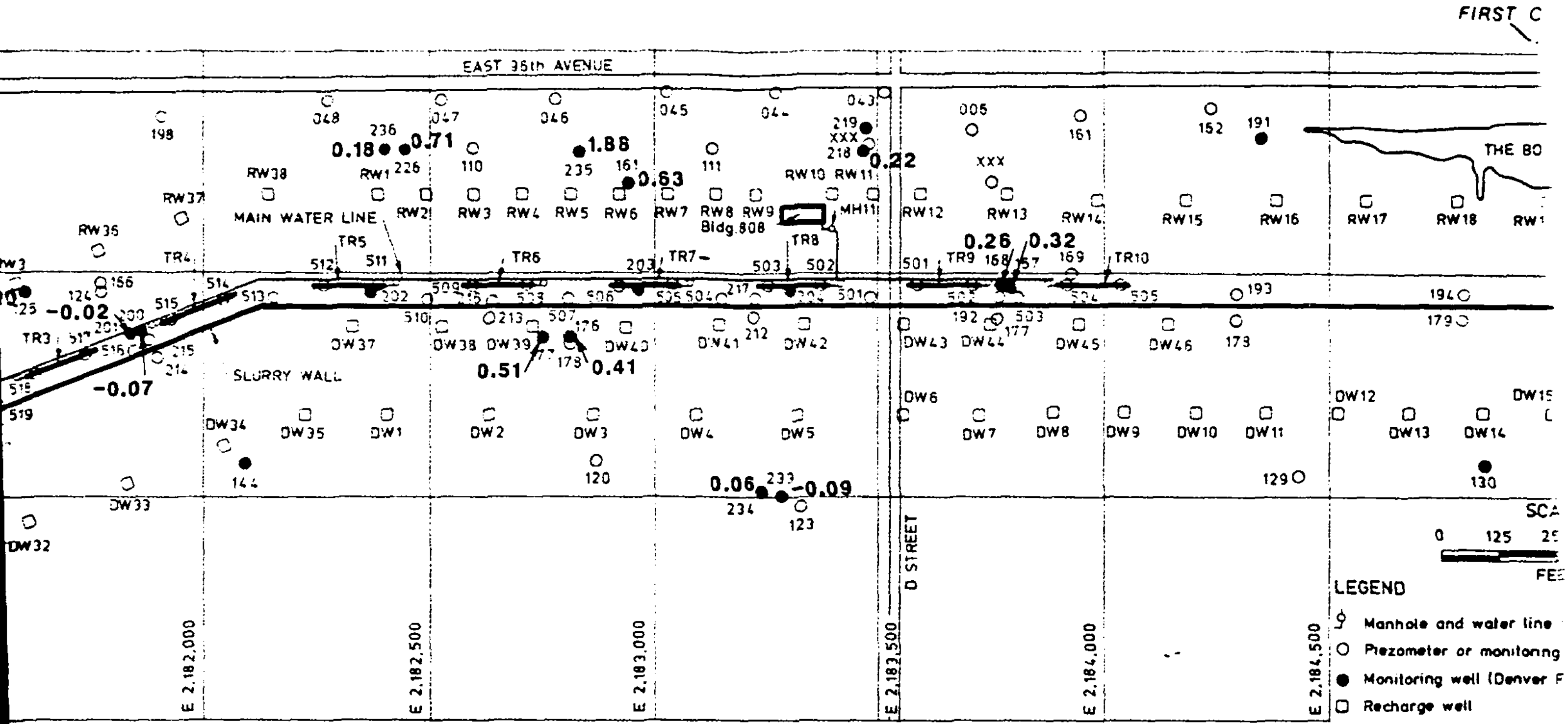
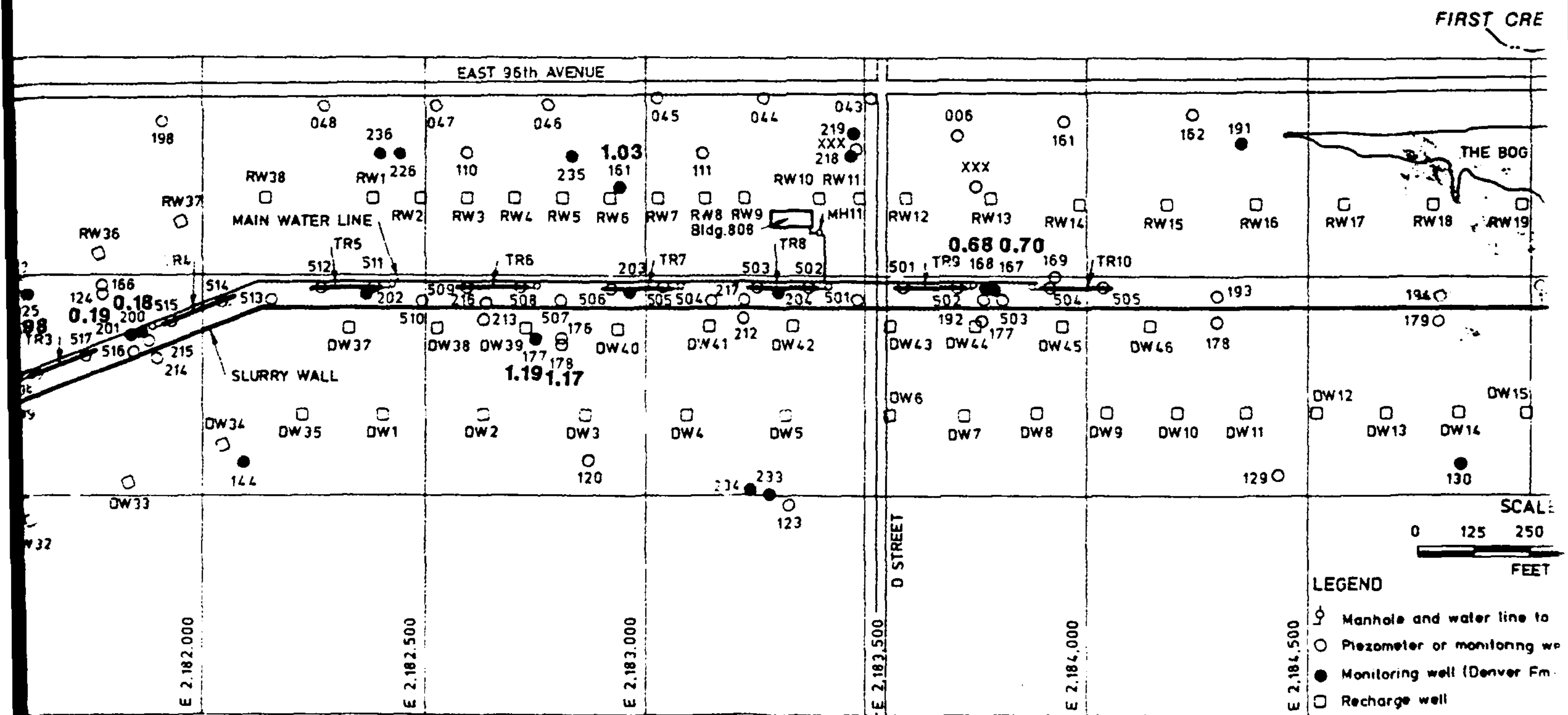


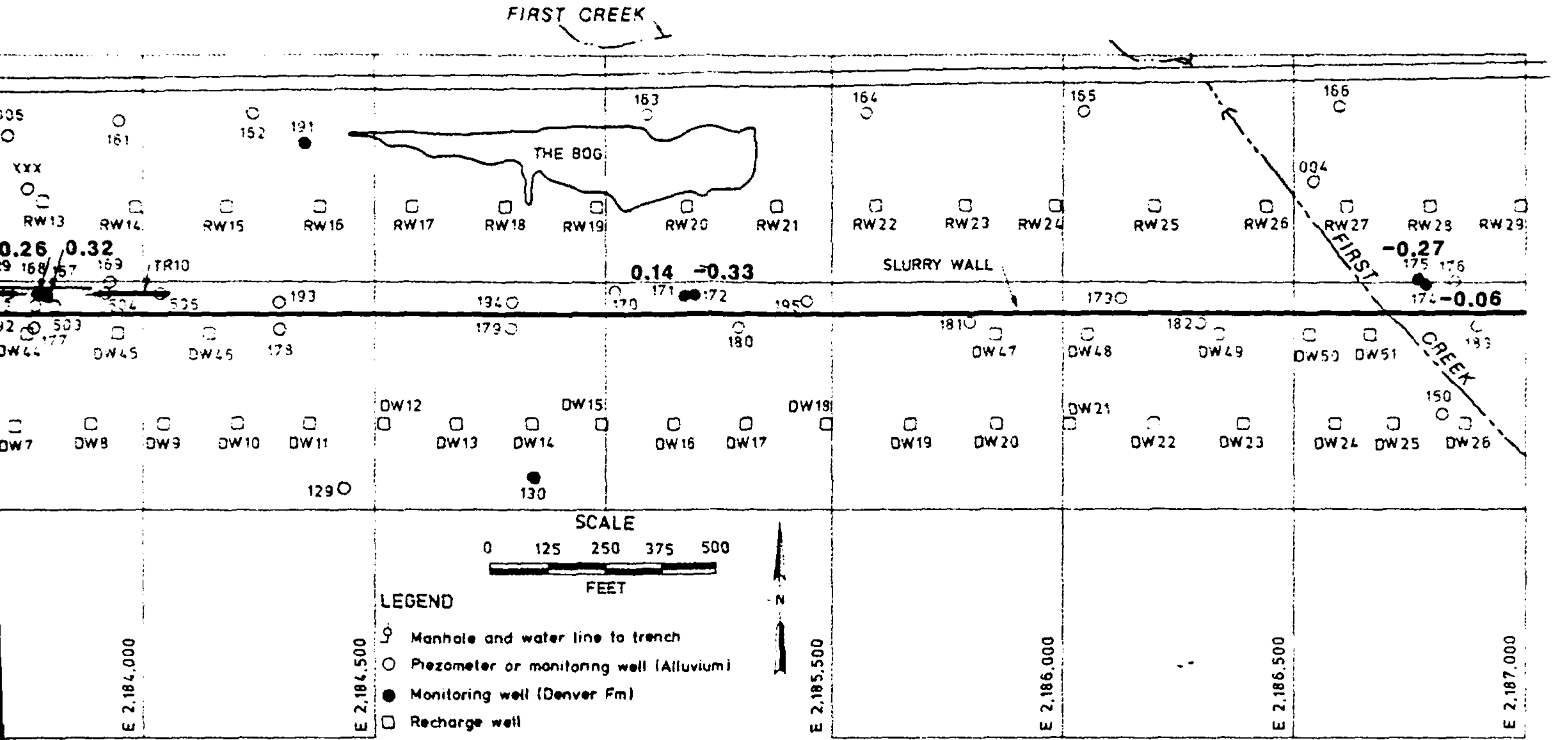
Figure 21. Level changes (ft) in Denver formation ground water



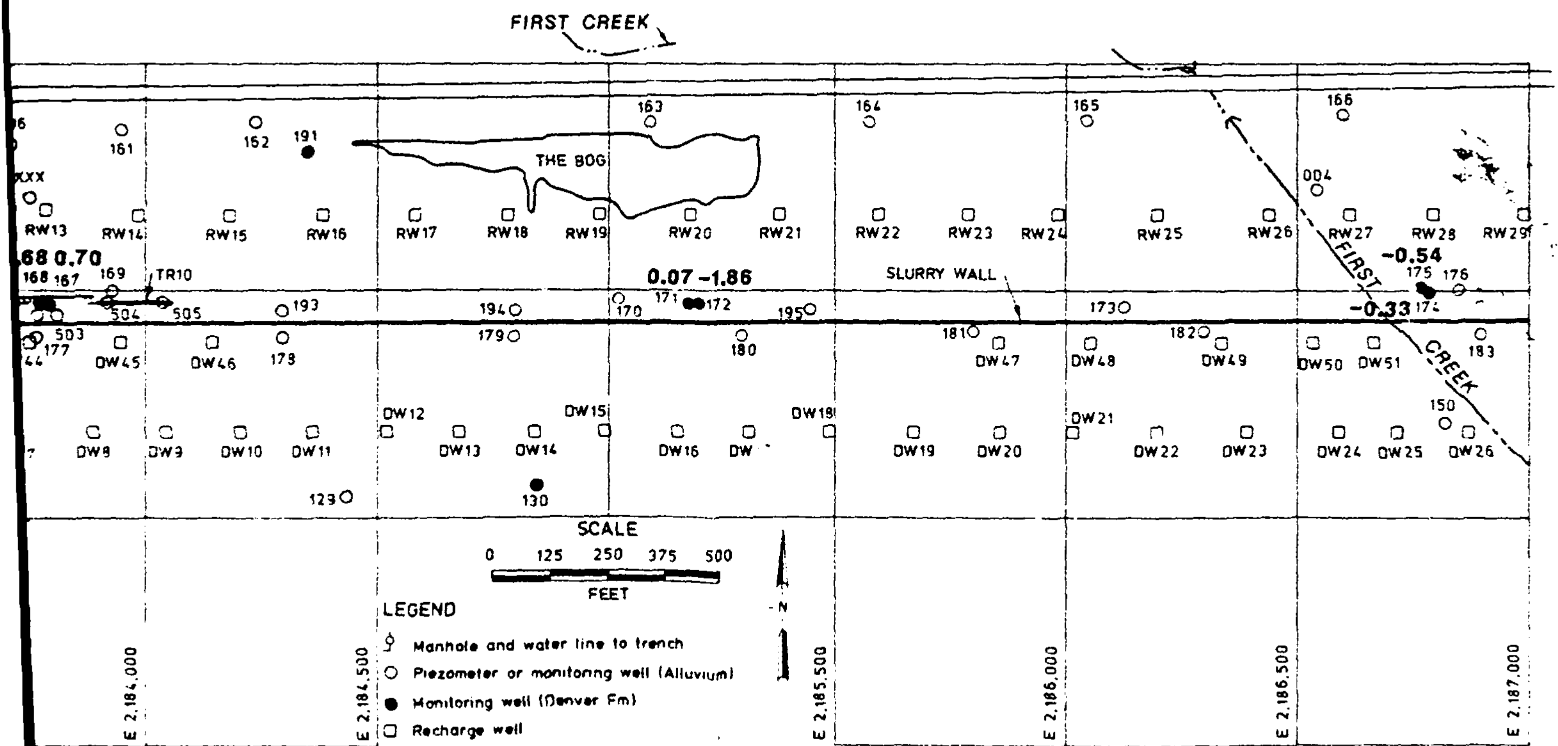
el changes (ft) in Denver formation ground water from 29 October to 30 November.



changes (ft) in Denver formation ground water from 30 November to 15 January.



ber to 30 November.



er to 15 January.

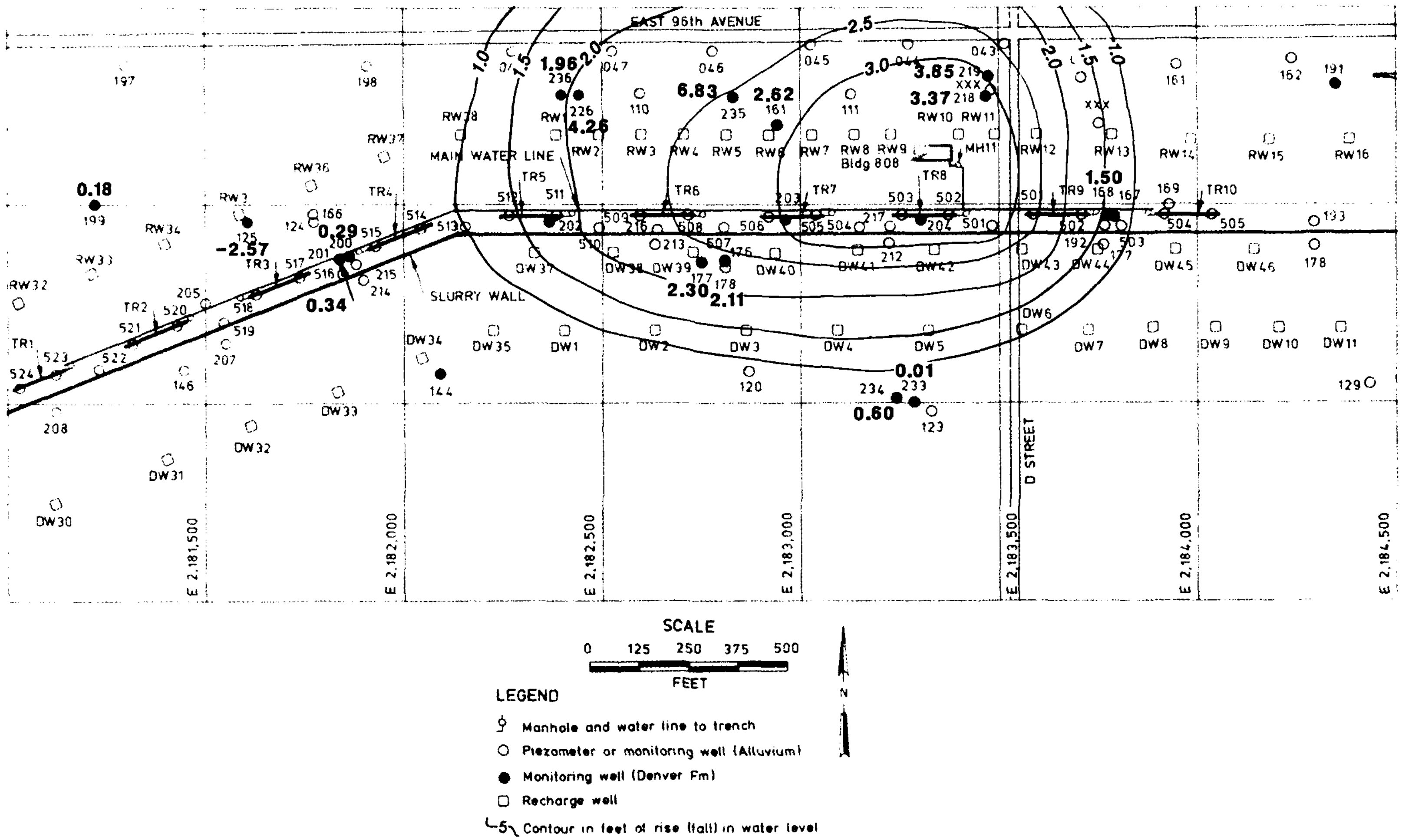


Figure 22. Level changes (ft) in Denver formation ground water from 29 October to 17 February in relation to barrier.

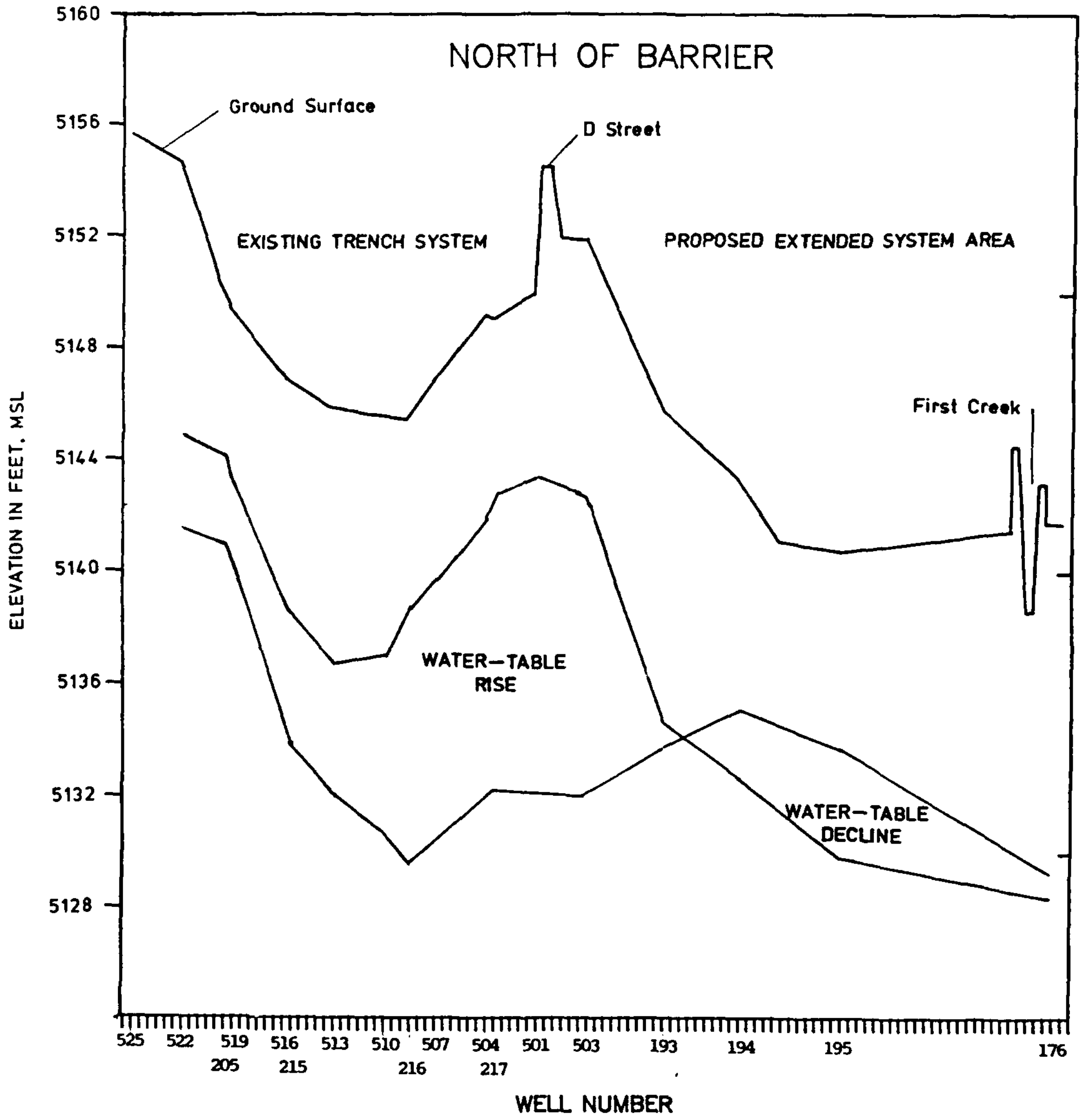


Figure 23. Rising and falling water table associated with recharge through existing trenches and the bog.

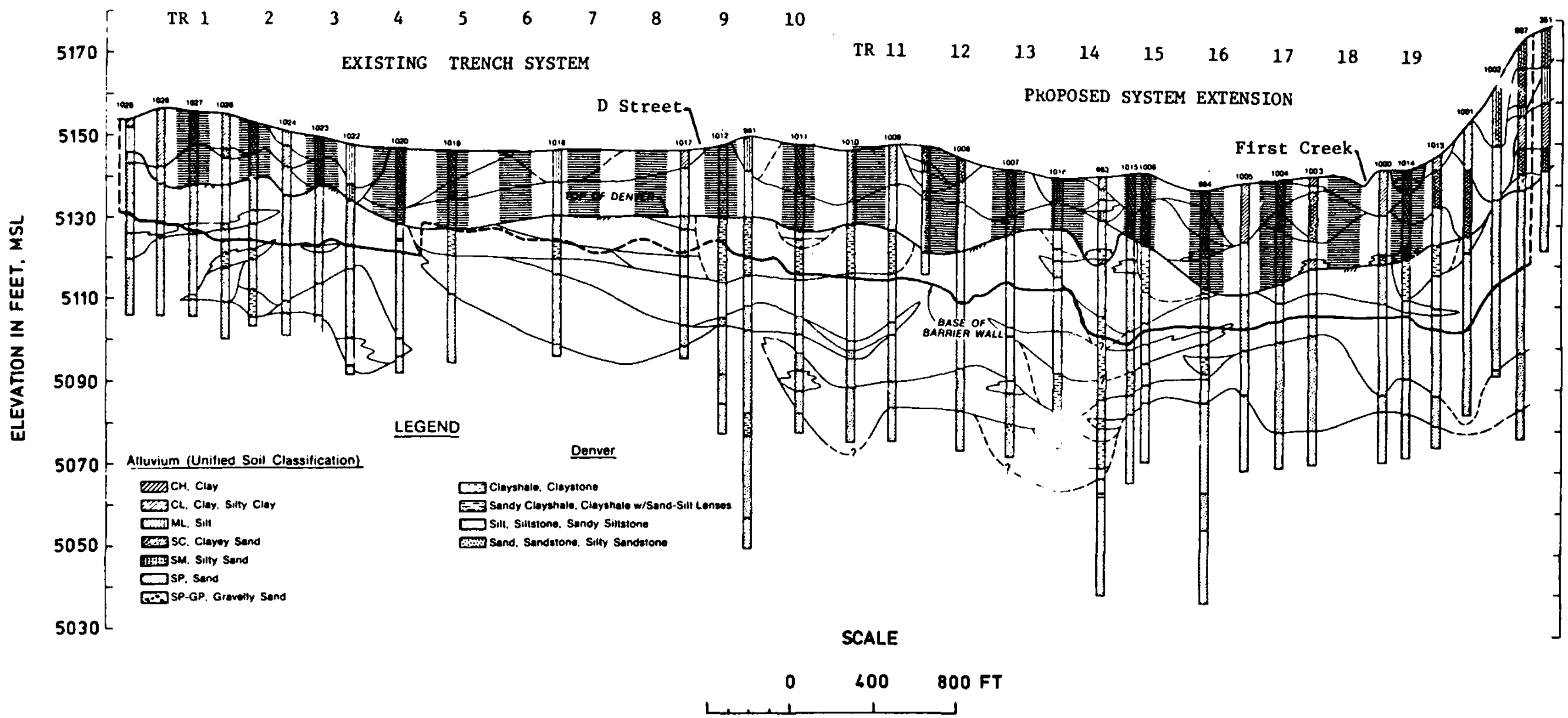


Figure 24. Potential trench locations and geological conditions for recharge system.

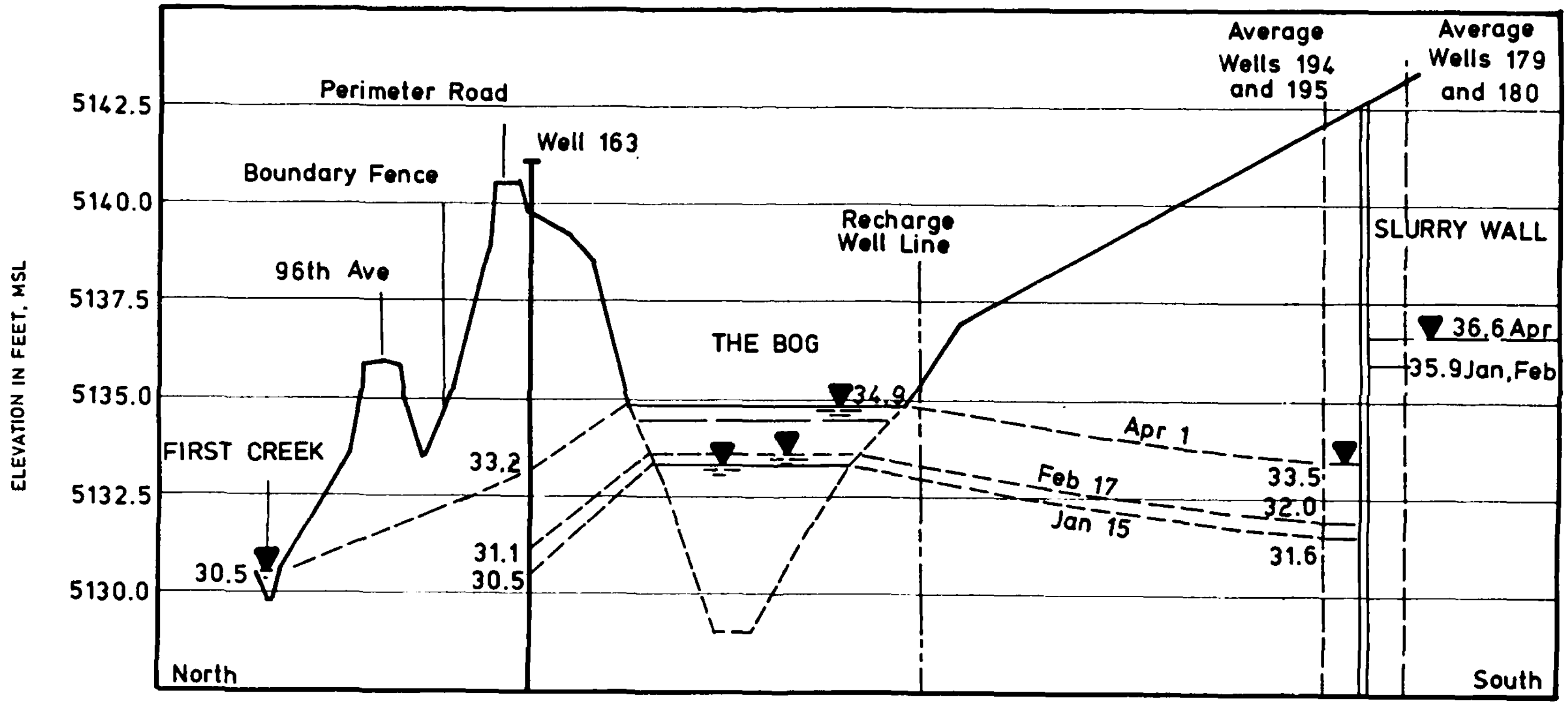


Figure 25. Fluctuations in ground-water profile from variations in bog level.

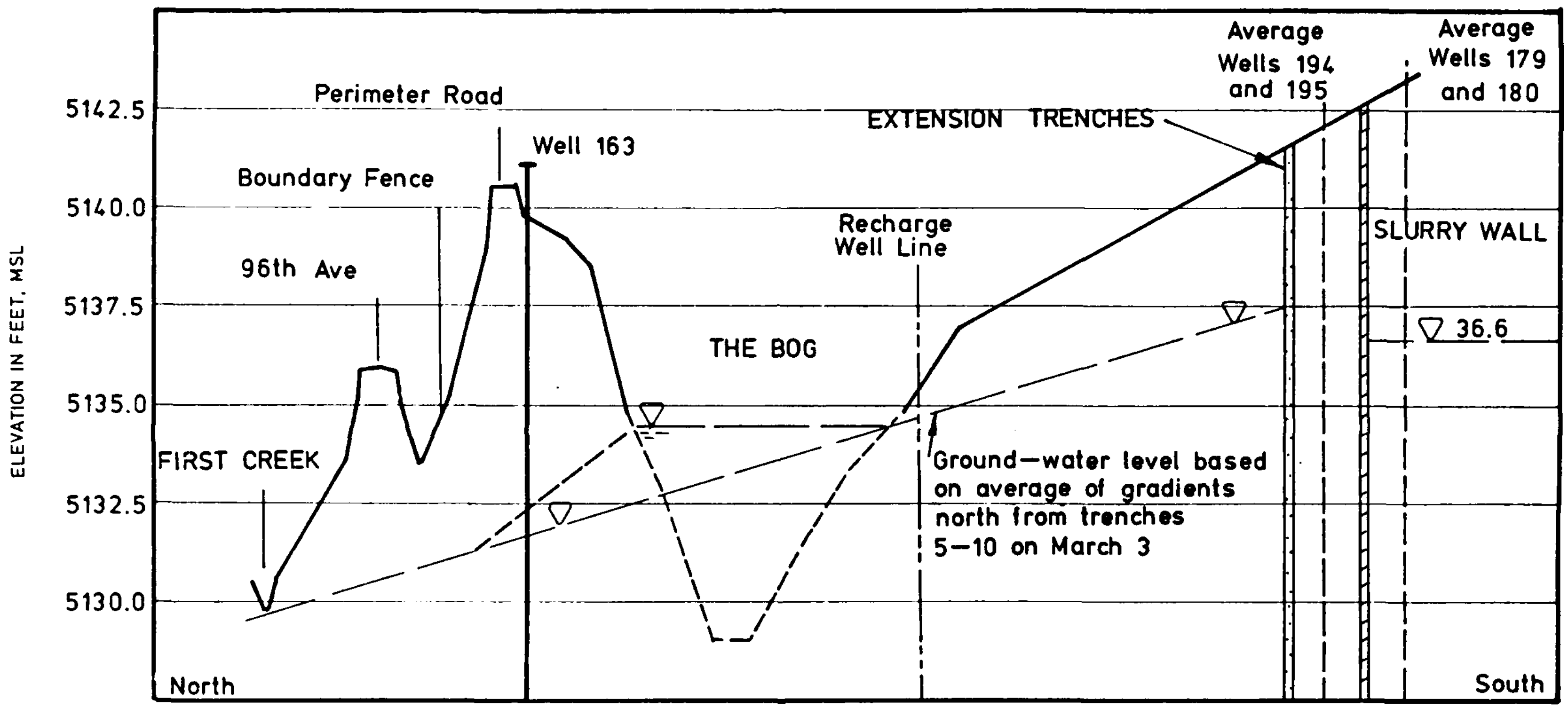


Figure 26. Approximate ground-water profile from proposed trenches 12-14.

APPENDIX A

SYSTEM DATA

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* Data contained in RIC files with added notes indicating probable errors.

N.B. WATER LEVELS: ALONG TRENCHES

WELL NO	TRENCH	DATE	TOC ELEV.	DEPTH (TOC)	WATER ELEV.	GPM (AVG.)	MANHOLE FLOOR ELEV.	REMARKS
23524	1	10/29/88	5156.52	15.52	5141.00		5147.50	
		11/25/88	5156.52	14.62	5141.90			
		11/30/88	5156.52	13.39	5143.13			
		12/05/88	5156.52	12.78	5143.74			
		12/09/88	5156.52	12.60	5143.92			
		12/23/88	5156.52	12.05	5144.47			
		12/30/88	5156.52	11.75	5144.77			
		01/06/89	5156.52	11.50	5145.02			
		01/13/89	5156.52	11.40	5145.12			
		01/20/89	5156.52	11.00	5145.52			
		01/27/89	5156.52	11.00	5145.52	5.30		
		02/03/89	5156.52	11.10	5145.42	8.70		
		02/10/89	5156.52	11.48	5145.04	4.30		
		02/17/89	5156.52	11.54	5144.98	3.70		
		02/24/89	5156.52	11.70	5144.82	3.80		
		03/03/89	5156.52	11.55	5144.97	2.60		
23523	1	10/29/88	5156.27	15.07	5141.20		5147.50	
		11/25/88	5156.27	14.21	5142.06			
		11/30/88	5156.27	13.05	5143.22			
		12/05/88	5156.27	12.50	5143.77			
		12/09/88	5156.27	12.25	5144.02			
		12/23/88	5156.27	11.75	5144.52			
		12/30/83	5156.27	11.50	5144.77			
		01/06/89	5156.27	11.25	5145.02			
		01/13/89	5156.27	11.20	5145.07			
		01/20/89	5156.27	10.80	5145.47			
		01/27/89	5156.27	10.65	5145.62	5.30		
		02/03/89	5156.27	10.85	5145.42	8.70		
		02/10/89	5156.27	11.17	5145.10	4.30		
		02/17/89	5156.27	11.32	5144.95	3.70		
		02/24/89	5156.27	11.45	5144.82	3.80		
		03/03/89	5156.27	11.20	5145.07	2.60		
23521	2	10/29/88	5155.34	14.48	5140.86		5143.74	
		11/25/88	5155.34	13.48	5141.86			
		11/30/88	5155.34	12.93	5142.41			
		12/05/88	5155.34	12.48	5142.86			
		12/09/88	5155.34	12.30	5143.04			
		12/23/88	5155.34	11.90	5143.44			
		12/30/88	5155.34	11.80	5143.54			
		01/06/89	5155.34	11.65	5143.69			
		01/13/89	5155.34	11.10	5144.24			
		01/20/89	5155.34	11.25	5144.09			
		01/27/89	5155.34	11.15	5144.19			
		02/03/89	5155.34	11.25	5144.09			
		02/10/89	5155.34	11.40	5143.94			
		02/17/89	5155.34	11.57	5143.77			
		02/24/89	5155.34	11.60	5143.74			

N.B. WATER LEVELS: ALONG TRENCHES

WELL NO	TRENCH	DATE	TOC ELEV.	DEPTH (TOC)	WATER ELEV.	GPM (AVG.)	MANHOLE FLOOR ELEV.	REMARKS
23521	2	03/03/89	5155.34	11.60	5143.74		5143.74	
23520	2	10/29/88	5153.41	12.76	5140.65		5143.74	
		11/25/88	5153.41	11.41	5142.00			
		11/30/88	5153.41	10.99	5142.42			
		12/05/88	5153.41	10.53	5142.88			
		12/09/88	5153.41	10.40	5143.01			
		12/23/88	5153.41	9.95	5143.46			
		12/30/88	5153.41	9.85	5143.56			
		01/06/89	5153.41	9.75	5143.66			
		01/13/89	5153.41	9.10	5144.31			
		01/20/89	5153.41	9.30	5144.11			
		01/27/89	5153.41	9.25	5144.16			
		02/03/89	5153.41	9.35	5144.06			
		02/10/89	5153.41	9.43	5143.98			
		02/17/89	5153.41	9.66	5143.75			
		02/24/89	5153.41	9.65	5143.76			
		03/03/89	5153.41	9.60	5143.81			
23518	3	10/29/88	5151.81	12.38	5139.43		5143.08	DRY
		11/25/88	5151.81	10.93	5140.88			
		11/30/88	5151.81	10.49	5141.32			
		12/05/88	5151.81	10.41	5141.40			
		12/09/88	5151.81	10.35	5141.46			
		12/23/88	5151.81	10.40	5141.41			
		12/30/88	5151.81	10.75	5141.06			
		01/06/89	5151.81	9.90	5141.91			
		01/13/89	5151.81	9.32	5142.49			
		01/20/89	5151.81	9.50	5142.31			
		01/27/89	5151.81	9.20	5142.61	2.50		
		02/03/89	5151.81	9.75	5142.06	1.70		
		02/10/89	5151.81	10.10	5141.71	0.00		
		02/17/89	5151.81	10.16	5141.65	0.00		
		02/24/89	5151.81	10.05	5141.76	0.00		
		03/03/89	5151.81	9.20	5142.61	0.60		
23517	3	10/29/88	5149.75	11.91	5137.84		5143.08	
		11/25/88	5149.75	8.91	5140.84			
		11/30/88	5149.75	8.41	5141.34			
		12/05/88	5149.75	8.34	5141.41			
		12/09/88	5149.75	8.25	5141.50			
		12/23/88	5149.75	8.30	5141.45			
		12/30/88	5149.75	8.65	5141.10			
		01/06/89	5149.75	7.80	5141.95			
		01/13/89	5149.75	7.25	5142.50			
		01/20/89	5149.75	7.15	5142.60			
		01/27/89	5149.75	7.10	5142.65	2.50		
		02/03/89	5149.75	7.65	5142.10	1.70		
		02/10/89	5149.75	7.99	5141.76	0.00		

N.B. WATER LEVELS: ALONG TRENCHES

WELL NO	TRENCH	DATE	TOC ELEV.	DEPTH (TOC)	WATER ELEV.	GPM (AVG.)	MANHOLE FLOOR ELEV.	REMARKS
23517	3	02/17/89	5149.75	8.07	5141.68	0.00	5143.08	
		02/24/89	5149.75	7.95	5141.80	0.00		
		03/03/89	5149.75	7.10	5142.65	0.60		
23515	4	10/29/88	5149.27	15.43	5133.84		5140.04	
		11/25/88	5149.27	11.63	5137.64			
		11/30/88	5149.27	11.33	5137.94			
		12/05/88	5149.27	11.02	5138.25			
		12/09/88	5149.27	11.15	5138.12			
		12/23/88	5149.27	11.80	5137.47			
		12/30/88	5149.27	12.25	5137.02			
		01/06/89	5149.27	11.45	5137.82			
		01/13/89	5149.27	10.90	5138.37			
		01/20/89	5149.27	10.55	5138.72			
		01/27/89	5149.27	10.30	5138.97	8.70		
		02/03/89	5149.27	10.10	5139.17	8.80		
		02/10/89	5149.27	12.18	5137.09	8.90		
		02/17/89	5149.27	10.13	5139.14	9.20		
		02/24/89	5149.27	9.60	5139.67	9.50		
		03/03/89	5149.27	9.20	5140.07	8.60		
23514	4	10/29/88	5148.14	14.28	5133.86		5140.04	
		11/25/88	5148.14	10.48	5137.66			
		11/30/88	5148.14	10.20	5137.94			
		12/05/88	5148.14	9.89	5138.25			
		12/09/88	5148.14	10.05	5138.09			
		12/23/88	5148.14	10.65	5137.49			
		12/30/88	5148.14	11.15	5136.99			
		01/06/89	5148.14	10.25	5137.89			
		01/13/89	5148.14	9.70	5138.44			
		01/20/89	5148.14	11.45	5136.69			
		01/27/89	5148.14	9.30	5138.84	8.70		
		02/03/89	5148.14	9.00	5139.14	8.80		
		02/10/89	5148.14	9.00	5139.14	8.90		
		02/17/89	5148.14	8.78	5139.36	9.20		
		02/24/89	5148.14	8.45	5139.69	9.50		
		03/03/89	5148.14	8.15	5139.99	8.60		
23512	5	10/29/88	5146.84	16.61	5130.23		5139.29	
		11/25/88	5146.84	12.21	5134.63			
		11/30/88	5146.84	12.17	5134.67			
		12/05/88	5146.84	11.40	5135.44			
		12/09/88	5146.84	11.55	5135.29			
		12/23/88	5146.84	10.00	5136.84			
		12/30/88	5146.84	9.90	5136.94			
		01/06/89	5146.84	9.85	5136.99			
		01/13/89	5146.84	9.50	5137.34			
		01/20/89	5146.84	9.35	5137.49			
		01/27/89	5146.84	9.15	5137.69	9.60		

N.B. WATER LEVELS: ALONG TRENCHES

WELL NO	TRENCH	DATE	TOC ELEV.	DEPTH (TOC)	WATER ELEV.	GPM (AVG.)	MANHOLE FLOOR ELEV.	REMARKS
23512	5	02/03/89	5146.84	8.60	5138.24	10.10	5139.29	
		02/10/89	5146.84	8.50	5138.34	10.30		
		02/17/89	5146.84	8.09	5138.75	10.40		
		02/24/89	5146.84	7.50	5139.34	10.80		
		03/03/89	5146.84	7.45	5139.39	9.50		
23511	5	10/29/88	5146.45	15.50	5130.95		5139.29	
		11/25/88	5146.45	11.80	5134.65			
		11/30/88	5146.45	11.77	5134.68			
		12/05/88	5146.45	10.98	5135.47			
		12/09/88	5146.45	11.10	5135.35			
		12/23/88	5146.45	9.70	5136.75			
		12/30/88	5146.45	9.50	5136.95			
		01/06/89	5146.45	9.40	5137.05			
		01/13/89	5146.45	9.10	5137.35			
		01/20/89	5146.45	8.95	5137.50			
		01/27/89	5146.45	8.70	5137.75	9.60		
		02/03/89	5146.45	8.25	5138.20	10.10		
		02/10/89	5146.45	7.96	5138.49	10.30		
		02/17/89	5146.45	7.69	5138.76	10.40		
		02/24/89	5146.45	7.15	5139.30	10.80		
		03/03/89	5146.45	7.10	5139.35	9.50		
23509	6	10/29/88	5147.63	17.74	5129.89		5141.22	
		11/25/88	5147.63	11.84	5135.79			
		11/30/88	5147.63	11.19	5136.44			
		12/05/88	5147.63	10.42	5137.21			
		12/09/88	5147.63	10.50	5137.13			
		12/23/88	5147.63	9.55	5138.08			
		12/30/88	5147.63	9.30	5138.33			
		01/06/89	5147.63	9.25	5138.38			
		01/13/89	5147.63	8.90	5138.73			
		01/20/89	5147.63	8.60	5139.03			
		01/27/89	5147.63	8.20	5139.43	16.30		
		02/03/89	5147.63	7.50	5140.13	17.30		
		02/10/89	5147.63	7.11	5140.52	18.40		
		02/17/89	5147.63	6.60	5141.03	20.00		
		03/03/89	5147.63	6.45	5141.18	18.20		
23508	6	10/29/88	5147.97	18.09	5129.88		5141.22	
		11/25/88	5147.97	11.89	5136.08			
		11/30/88	5147.97	11.47	5136.50			
		12/05/88	5147.97	10.71	5137.26			
		12/09/88	5147.97	10.80	5137.17			
		12/23/88	5147.97	9.90	5138.07			
		12/30/88	5147.97	9.60	5138.37			
		01/06/89	5147.97	9.60	5138.37			
		01/13/89	5147.97	9.20	5138.77			
		01/20/89	5147.97	8.85	5139.12			

N.B. WATER LEVELS: ALONG TRENCHES

WELL NO	TRENCH	DATE	TOC ELEV.	DEPTH (TOC)	WATER ELEV.	GPM (AVG.)	MANHOLE FLOOR ELEV.	REMARKS
23508	6	01/27/89	5147.97	8.50	5139.47	16.30	5141.22	
		02/03/89	5147.97	11.85	5136.12	17.30		DRY
		02/10/89	5147.97	7.50	5140.47	18.40		
		02/17/89	5147.97	7.03	5140.94	20.00		
		03/03/89	5147.97	6.85	5141.12	18.20		
23506	7	10/29/88	5150.42	17.54	5132.88		5144.07	DRY
		11/25/88	5150.42	13.14	5137.28			
		11/30/88	5150.42	12.15	5138.27			
		12/05/88	5150.42	11.08	5139.34			
		12/09/88	5150.42	11.25	5139.17			
		12/23/88	5150.42	10.35	5140.07			
		12/30/88	5150.42	10.10	5140.32			
		01/06/89	5150.42	10.10	5140.32			
		01/13/89	5150.42	9.60	5140.82			
		01/20/89	5150.42	9.15	5141.27			
		01/27/89	5150.42	8.70	5141.72	41.60		
		02/03/89	5150.42	8.00	5142.42	44.30		
		02/10/89	5150.42	7.85	5142.57	47.20		
		02/17/89	5150.42	7.41	5143.01	48.90		
		03/03/89	5150.42	7.35	5143.07	43.80		
23505	7	10/29/88	5151.59	19.05	5132.54		5144.07	DRY
		11/25/88	5151.59	13.15	5138.44			
		11/30/88	5151.59	12.78	5138.81			
		12/05/88	5151.59	12.07	5139.52			
		12/09/88	5151.59	12.20	5139.39			
		12/23/88	5151.59	11.40	5140.19			
		12/30/88	5151.59	11.10	5140.49			
		01/06/89	5151.59	11.25	5140.34			
		01/13/89	5151.59	10.70	5140.89			
		01/20/89	5151.59	10.20	5141.39			
		01/27/89	5151.59	9.80	5141.79	41.60		
		02/03/89	5151.59	9.10	5142.49	44.30		
		02/10/89	5151.59	9.00	5142.59	47.20		
		02/17/89	5151.59	8.51	5143.08	48.90		
		03/03/89	5151.59	8.45	5143.14	43.80		
23503	8	10/29/88	5152.41	17.83	5134.5[illegible]		5144.61	
		11/25/88	5152.41	13.53	5138.88			
		11/30/88	5152.41	12.21	5140.20			
		12/05/88	5152.41	11.27	5141.14			
		12/09/88	5152.41	11.45	5140.96			
		12/23/88	5152.41	10.65	5141.76			
		12/30/88	5152.41	10.15	5142.26			
		01/06/89	5152.41	10.15	5142.26			
		01/13/89	5152.41	9.30	5143.11			
		01/20/89	5152.41	8.75	5143.66			
		01/27/89	5152.41	8.75	5143.66	42.30		

N.B. WATER LEVELS: ALONG TRENCHES

WELL NO	TRENCH	DATE	TOC ELEV.	DEPTH (TOC)	WATER ELEV.	GPM (AVG.)	MANHOLE FLOOR ELEV.	REMARKS
23503	8	02/03/89	5152.41	8.25	5144.16	41.80	5144.61	
		02/10/89	5152.41	8.40	5144.01	39.00		
		02/17/89	5152.41	8.17	5144.24	37.70		
		03/03/89	5152.41	8.20	5144.21	33.70		
23502	8	10/29/88	5151.93	17.90	5134.03		5144.61	NEAR BOTTOM
		11/25/88	5151.93	11.77	5140.16			
		11/30/88	5151.93	11.33	5140.60			
		12/05/88	5151.93	10.59	5141.34			
		12/09/88	5151.93	10.77	5141.16			
		12/23/88	5151.93	10.05	5141.88			
		12/30/88	5151.93	9.55	5142.38			
		01/06/89	5151.93	9.40	5142.53			
		01/13/89	5151.93	8.60	5143.33			
		01/20/89	5151.93	8.10	5143.83			
		01/27/89	5151.93	7.75	5144.18	42.30		
		02/03/89	5151.93	7.60	5144.33	41.80		
		02/10/89	5151.93	7.55	5144.38	39.00		
		02/17/89	5151.93	7.55	5144.38	37.70		
		03/03/89	5151.93	7.60	5144.33	33.70		
24501	9	10/29/88	5154.82	19.39	5135.43		5144.88	DRY
		11/25/88	5154.82	14.59	5140.23			
		11/30/88	5154.82	13.76	5141.06			
		12/05/88	5154.82	12.98	5141.84			
		12/09/88	5154.82	13.35	5141.47			
		12/23/88	5154.82	12.45	5142.37			
		12/30/88	5154.82	11.90	5142.92			
		01/06/89	5154.82	11.45	5143.37			
		01/13/89	5154.82	10.65	5144.17			
		01/20/89	5154.82	10.75	5144.07			
		01/27/89	5154.82	10.40	5144.42	31.70		
		02/03/89	5154.82	10.65	5144.17	29.60		
		02/10/89	5154.82	10.65	5144.17	15.50		
		02/17/89	5154.82	10.50	5144.32	28.30		
		03/03/89	5154.82	10.70	5144.12	25.50		
24502	9	10/29/88	5153.87	16.21	5137.66		5144.88	DRY
		11/25/88	5153.87	13.36	5140.51			
		11/30/88	5153.87	12.63	5141.24			
		12/05/88	5153.87	11.89	5141.98			
		12/09/88	5153.87	12.15	5141.72			
		12/23/88	5153.87	11.40	5142.47			
		12/30/88	5153.87	10.85	5143.02			
		01/06/89	5153.87	10.40	5143.47			
		01/13/89	5153.87	9.60	5144.27			
		01/20/89	5153.87	9.70	5144.17			
		01/27/89	5153.87	9.50	5144.37	31.70		
		02/03/89	5153.87	9.70	5144.17	29.60		

N.B. WATER LEVELS: ALONG TRENCHES

WELL NO	TRENCH	DATE	TOC ELEV.	DEPTH (TOC)	WATER ELEV.	GPM (AVG.)	MANHOLE FLOOR ELEV.	REMARKS
24502	9	02/10/89	5153.87	9.65	5144.22	15.50	5144.88	
		02/17/89	5153.87	9.50	5144.37	28.30		
		03/03/89	5153.87	9.70	5144.17	25.50		
24504	10	10/29/88	5151.76	19.19	5132.57		5143.95	
		11/25/88	5151.76	12.69	5139.07			
		11/30/88	5151.76	12.01	5139.75			
		12/05/88	5151.76	11.23	5140.53			
		12/09/88	5151.76	11.45	5140.31			
		12/23/88	5151.76	10.65	5141.11			
		12/30/88	5151.76	10.55	5141.21			
		01/06/89	5151.76	10.00	5141.76			
		01/13/89	5151.76	9.35	5142.41			
		01/20/89	5151.76	8.75	5143.01			
		01/27/89	5151.76	8.50	5143.26	18.70		
		02/03/89	5151.76	8.40	5143.36	18.40		
		02/10/89	5151.76	10.60	5141.16	16.80		
		02/17/89	5151.76	8.60	5143.16	15.70		
		03/03/89	5151.76	8.65	5143.11	14.50		
24505	10	10/29/88	5150.44	17.79	5132.65		5143.95	
		11/25/88	5150.44	11.39	5139.05			
		11/30/88	5150.44	10.76	5139.68			
		12/05/88	5150.44	9.98	5140.46			
		12/09/88	5150.44	10.15	5140.29			
		12/23/88	5150.44	9.70	5140.74			
		12/30/88	5150.44	9.25	5141.19			
		01/06/89	5150.44	8.70	5141.74			
		01/13/89	5150.44	8.10	5142.34			
		01/20/89	5150.44	7.40	5143.04			
		01/27/89	5150.44	7.00	5143.44	18.70		
		02/03/89	5150.44	7.10	5143.34	18.40		
		02/10/89	5150.44	7.35	5143.09	16.80		
		02/17/89	5150.44	7.35	5143.09	15.70		
		03/03/89	5150.44	7.30	5143.14	14.50		

N.B. WATER LEVELS: NORTH OF BARRIER

WELL NO	AQUIF TYPE	DATE	TOC ELEV.	DEPTH (TOC)	WATER ELEV.	REMARKS
23525		10/29/88	5157.73	11.36	5146.37	DRY
		11/25/88	5157.73	11.36	5146.37	DRY
		12/09/88	5157.73	11.30	5146.43	DRY
		12/23/88	5157.73	11.00	5146.73	DRY
		12/30/88	5157.73	11.00	5146.73	DRY
		01/06/89	5157.73	8.70	5149.03	PROB ERROR
		01/13/89	5157.73	11.00	5146.73	DRY
		01/20/89	5157.73	11.00	5146.73	DRY
		01/27/89	5157.73	11.00	5146.73	DRY
		02/03/89	5157.73	11.00	5146.73	DRY
		02/10/89	5157.73	11.50	5146.23	DRY
		02/17/89	5157.73	11.00	5146.73	DRY
		02/24/89	5157.73	11.00	5146.73	DRY
		03/03/89	5157.73	11.00	5146.73	DRY
23522		10/29/88	5156.67	14.99	5141.68	
		11/25/88	5156.67	14.85	5141.82	
		12/09/88	5156.67	13.28	5143.39	
		12/23/88	5156.67	12.70	5143.97	
		12/30/88	5156.67	12.50	5144.17	
		01/06/89	5156.67	12.35	5144.32	
		01/13/89	5156.67	12.10	5144.57	
		01/20/89	5156.67	11.90	5144.77	
		01/27/89	5156.67	11.75	5144.92	
		02/03/89	5156.67	11.95	5144.72	
		02/10/89	5156.67	12.07	5144.60	
		02/17/89	5156.67	12.25	5144.42	
		02/24/89	5156.67	12.32	5144.35	
		03/03/89	5156.67	12.30	5144.37	
23205	ALL	10/29/88	5151.30	10.20	5141.10	
		11/25/88	5151.30	9.15	5142.15	
		12/09/88	5151.30	8.32	5142.98	
		12/23/88	5151.30	7.95	5143.35	
		12/30/88	5151.30	8.05	5143.25	
		01/06/89	5151.30	7.80	5143.50	
		01/13/89	5151.30	7.35	5143.95	
		01/20/89	5151.30	7.20	5144.10	
		01/27/89	5151.30	7.10	5144.20	
		02/03/89	5151.30	7.15	5144.15	
		02/10/89	5151.30	7.51	5143.79	
		02/17/89	5151.30	7.68	5143.62	
		02/24/89	5151.30	7.60	5143.70	
		03/03/89	5151.30	7.40	5143.90	
23519		10/29/88	5151.84	11.71	5140.13	
		11/25/88	5151.84	10.71	5141.13	
		12/09/88	5151.84	9.85	5141.99	
		12/23/88	5151.84	9.50	5142.34	
		12/30/88	5151.84	9.65	5142.19	

N.B. WATER LEVELS: NORTH OF BARRIER

WELL NO	AQUIF TYPE	DATE	TOC ELEV.	DEPTH (TOC)	WATER ELEV.	REMARKS
23519		01/06/89	5151.84	9.40	5142.44	
		01/13/89	5151.84	8.90	5142.94	
		01/20/89	5151.84	8.70	5143.14	
		01/27/89	5151.84	8.65	5143.19	
		02/03/89	5151.84	8.65	5143.19	
		02/10/89	5151.84	9.08	5142.76	
		02/17/89	5151.84	9.24	5142.60	
		02/24/89	5151.84	9.20	5142.64	
		03/03/89	5151.84	8.90	5142.94	
23516		10/29/88	5149.26	14.12	5135.14	DRY
		11/25/88	5149.26	14.12	5135.14	DRY
		12/09/88	5149.26	13.57	5135.69	
		12/23/88	5149.26	13.35	5135.91	
		12/30/88	5149.26	13.30	5135.96	
		01/06/89	5149.26	13.30	5135.96	
		01/13/89	5149.26	13.20	5136.06	
		01/20/89	5149.26	13.05	5136.21	
		01/27/89	5149.26	12.95	5136.31	
		02/03/89	5149.26	13.10	5136.16	
		02/10/89	5149.26	12.68	5136.58	
		02/17/89	5149.26	12.54	5136.72	
		02/24/89	5149.26	12.40	5136.86	
		03/03/89	5149.26	12.30	5136.96	
23215		10/29/88	5148.10	14.20	5133.90	
		11/25/88	5148.10	10.80	5137.30	
		12/09/88	5148.10	10.30	5137.80	
		12/23/88	5148.10	10.75	5137.35	
		12/30/88	5148.10	11.20	5136.90	
		01/06/89	5148.10	10.55	5137.55	
		01/13/89	5148.10	10.00	5138.10	
		01/20/89	5148.10	9.75	5138.35	
		01/27/89	5148.10	9.55	5138.55	
		02/03/89	5148.10	9.80	5138.30	
		02/10/89	5148.10	9.35	5138.75	
		02/17/89	5148.10	9.26	5138.84	
		02/24/89	5148.10	8.90	5139.20	
		03/03/89	5148.10	8.60	5139.50	
23513		10/29/88	5147.96	15.80	5132.16	
		11/25/88	5147.96	13.10	5134.86	
		12/09/88	5147.96	12.60	5135.36	
		12/23/88	5147.96	12.15	5135.81	
		12/30/88	5147.96	12.10	5135.86	
		01/06/89	5147.96	11.90	5136.06	
		01/13/89	5147.96	11.60	5136.36	
		01/20/89	5147.96	11.40	5136.56	
		01/27/89	5147.96	11.20	5136.76	
		02/03/89	5147.96	11.45	5136.51	

N.B. WATER LEVELS: NORTH OF BARRIER

WELL NO	AQUIF TYPE	DATE	TOC ELEV.	DEPTH (TOC)	WATER ELEV.	REMARKS
23513		02/10/89	5147.96	10.71	5137.25	
		02/17/89	5147.96	10.45	5137.51	
		02/24/89	5147.96	9.70	5138.26	
		03/03/89	5147.96	9.70	5138.26	
23510		10/29/88	5147.58	16.77	5130.81	NEAR BOTTOM
		11/25/88	5147.58	14.02	5133.56	
		12/09/88	5147.58	13.00	5134.58	
		12/23/88	5147.58	11.90	5135.68	
		12/30/88	5147.58	11.50	5136.08	
		01/06/89	5147.58	11.30	5136.28	
		01/13/89	5147.58	11.10	5136.48	
		01/20/89	5147.58	10.80	5136.78	
		01/27/89	5147.58	10.50	5137.08	
		02/03/89	5147.58	10.70	5136.88	
		02/10/89	5147.58	9.83	5137.75	
		02/17/89	5147.58	9.40	5138.18	
		03/03/89	5147.58	8.70	5138.88	
23216		10/29/88	5146.50	16.82	5129.68	
		11/25/88	5146.50	11.02	5135.48	
		12/09/88	5146.50	9.70	5136.80	
		12/23/88	5146.50	8.75	5137.75	
		12/30/88	5146.50	8.55	5137.95	
		01/06/89	5146.50	8.35	5138.15	
		01/13/89	5146.50	8.15	5138.35	
		01/20/89	5146.50	7.75	5138.75	
		01/27/89	5146.50	7.70	5138.80	
		02/03/89	5146.50	7.70	5138.80	
		02/10/89	5146.50	0.00	0.00	LOCKED
		02/17/89	5146.50	5.90	5140.60	
		03/03/89	5146.50	5.75	5140.75	
23507		10/29/88	5149.14	16.37	5132.77	DRY
		11/25/88	5149.14	14.07	5135.07	
		12/09/88	5149.14	11.88	5137.26	
		12/23/88	5149.14	11.05	5138.09	
		12/30/88	5149.14	10.60	5138.54	
		01/06/89	5149.14	10.45	5138.69	
		01/13/89	5149.14	10.20	5138.94	
		01/20/89	5149.14	9.65	5139.49	
		01/27/89	5149.14	9.25	5139.89	
		02/03/89	5149.14	9.64	5139.50	
		02/10/89	5149.14	8.35	5140.79	
		02/17/89	5149.14	7.95	5141.19	
		03/03/89	5149.14	7.75	5141.39	
23504		10/29/88	5151.21	16.74	5134.47	DRY
		11/25/88	5151.21	13.69	5137.52	
		12/09/88	5151.21	11.87	5139.34	

N.B. WATER LEVELS: NORTH OF BARRIER

WELL NO	AQUIF TYPE	DATE	TOC ELEV.	DEPTH (TOC)	WATER ELEV.	REMARKS
23504		12/23/88	5151.21	11.25	5139.96	
		12/30/88	5151.21	10.70	5140.51	
		01/06/89	5151.21	10.50	5140.71	
		01/13/89	5151.21	10.10	5141.11	
		01/20/89	5151.21	9.55	5141.66	
		01/27/89	5151.21	9.20	5142.01	
		02/03/89	5151.21	9.50	5141.71	
		02/10/89	5151.21	9.75	5141.46	
		02/17/89	5151.21	8.49	5142.72	
		03/03/89	5151.21	8.40	5142.81	
23217		10/29/88	5150.70	18.40	5132.30	
		11/25/88	5150.70	12.80	5137.90	
		12/09/88	5150.70	10.80	5139.90	
		12/23/88	5150.70	10.10	5140.60	
		12/30/88	5150.70	9.50	5141.20	
		01/06/89	5150.70	9.30	5141.40	
		01/13/89	5150.70	8.80	5141.90	
		01/20/89	5150.70	8.20	5142.50	
		01/27/89	5150.70	7.80	5142.90	
		02/03/89	5150.70	8.10	5142.60	
		02/10/89	5150.70	7.55	5143.15	
		02/17/89	5150.70	7.51	5143.19	
		03/03/89	5150.70	7.45	5143.25	
23501		10/29/88	5151.92	18.14	5133.78	DRY
		11/25/88	5151.92	12.89	5139.03	
		12/09/88	5151.92	13.20	5138.72	
		12/23/88	5151.92	10.80	5141.12	
		12/30/88	5151.92	10.05	5141.87	
		01/06/89	5151.92	9.70	5142.22	
		01/13/89	5151.92	9.10	5142.82	
		01/20/89	5151.92	8.70	5143.22	
		01/27/89	5151.92	8.40	5143.52	
		02/03/89	5151.92	10.70	5141.22	
		02/10/89	5151.92	7.35	5144.57	
		02/17/89	5151.92	8.30	5143.62	
		03/03/89	5151.92	8.30	5143.62	
24192	ALL	10/29/88	5153.30	21.21	5132.09	
		11/25/88	5153.30	14.51	5138.79	
		12/09/88	5153.30	12.95	5140.35	
		12/23/88	5153.30	12.40	5140.90	
		12/30/88	5153.30	11.70	5141.60	
		01/06/89	5153.30	11.25	5142.05	
		01/13/89	5153.30	10.55	5142.75	
		01/20/89	5153.30	10.30	5143.00	
		01/27/89	5153.30	10.35	5142.95	
		02/03/89	5153.30	10.25	5143.05	
		02/10/89	5153.30	10.50	5142.80	

N.B. WATER LEVELS: NORTH OF BARRIER

WELL NO	AQUIF TYPE	DATE	TOC ELEV.	DEPTH (TOC)	WATER ELEV.	REMARKS
24192	ALL	02/17/89	5153.30	10.05	5143.25	
		03/03/89	5153.30	10.20	5143.10	
24503		10/29/88	5153.66	21.02	5132.64	DRY
		11/25/88	5153.66	15.32	5138.34	
		12/09/88	5153.66	13.70	5139.96	
		12/23/88	5153.66	13.20	5140.46	
		12/30/88	5153.66	12.45	5141.21	
		01/06/89	5153.66	12.50	5141.16	
		01/13/89	5153.66	11.35	5142.31	
		01/20/89	5153.66	10.95	5142.71	
		01/27/89	5153.66	10.90	5142.76	
		02/03/89	5153.66	10.90	5142.76	
		02/10/89	5153.66	10.65	5143.01	
		02/17/89	5153.66	10.65	5143.01	
		03/03/89	5153.66	10.60	5143.06	
24193	ALL	10/29/88	5147.30	13.44	5133.86	
		11/25/88	5147.30	13.44	5133.86	
		12/09/88	5147.30	13.35	5133.95	
		12/23/88	5147.30	13.45	5133.85	
		12/30/88	5147.30	13.30	5134.00	
		01/06/89	5147.30	12.95	5134.35	
		01/13/89	5147.30	12.80	5134.50	
		01/20/89	5147.30	12.50	5134.80	
		01/27/89	5147.30	12.50	5134.80	
		02/03/89	5147.30	12.40	5134.90	
		02/10/89	5147.30	11.85	5135.45	
		02/17/89	5147.30	11.55	5135.75	
		03/03/89	5147.30	11.20	5136.10	
24194	ALL	10/29/88	5145.10	9.88	5135.22	
		11/25/88	5145.10	10.78	5134.32	
		12/09/88	5145.10	11.35	5133.75	
		12/23/88	5145.10	12.10	5133.00	
		12/30/88	5145.10	12.35	5132.75	
		01/06/89	5145.10	11.15	5133.95	
		01/13/89	5145.10	12.15	5132.95	
		01/20/89	5145.10	12.20	5132.90	
		01/27/89	5145.10	12.20	5132.90	
		02/03/89	5145.10	12.10	5133.00	
		02/10/89	5145.10	11.35	5133.75	
		02/17/89	5145.10	11.20	5133.90	
		03/03/89	5145.10	10.80	5134.30	
24195	ALL	10/29/88	5142.10	8.27	5133.83	
		11/25/88	5142.10	9.82	5132.28	
		12/09/88	5142.10	10.67	5131.43	
		12/23/88	5142.10	7.35	5134.75	PROB ERROR
		12/30/88	5142.10	11.65	5130.45	

N.B. WATER LEVELS: NORTH OF BARRIER

WELL NO	AQUIF TYPE	DATE	TOC ELEV.	DEPTH (TOC)	WATER ELEV.	REMARKS
24195	ALL	01/06/89	5142.10	11.95	5130.15	
		01/13/89	5142.10	12.10	5130.00	
		01/20/89	5142.10	12.00	5130.10	
		01/27/89	5142.10	12.05	5130.05	
		02/03/89	5142.10	12.00	5130.10	
		02/10/89	5142.10	12.11	5129.99	
		02/17/89	5142.10	12.03	5130.07	
		03/03/89	5142.10	11.30	5130.80	
24176	ALL	10/29/88	5141.70	12.30	5129.40	BROKEN TOC
		11/25/88	5141.70	12.55	5129.15	
		12/09/88	5141.70	12.80	5128.90	MEAS @GRND
		12/23/88	5141.70	12.25	5129.45	
		12/30/88	5141.70	12.45	5129.25	
		01/06/89	5141.70	12.75	5128.95	MEAS @GRND
		01/13/89	5141.70	13.00	5128.70	MEAS @GRND
		01/20/89	5141.70	13.05	5128.65	MEAS @GRND
		01/27/89	5141.70	13.05	5128.65	MEAS @GRND
		02/03/89	5141.70	13.00	5128.70	MEAS @GRND
		02/10/89	5141.70	13.00	5128.70	MEAS @GRND
		02/17/89	5141.70	13.24	5128.46	
		03/03/89	5141.70	13.15	5128.55	MEAS @GRND

N.B. WATER LEVELS: SOUTH OF BARRIER

WELL NO	AQUIF TYPE	DATE	TOC ELEV.	DEPTH (TOC)	WATER ELEV.	REMARKS
23208	ALL	10/29/88	5158.76	18.60	5140.16	
		11/25/88	5158.76	18.65	5140.11	
		12/09/88	5158.76	18.55	5140.21	
		12/23/88	5158.76	18.45	5140.31	
		12/30/88	5158.76	18.40	5140.36	
		01/06/89	5158.76	18.50	5140.26	
		01/13/89	5158.76	18.40	5140.36	
		01/20/89	5158.76	18.30	5140.46	
		01/27/89	5158.76	18.30	5140.46	
		02/03/89	5158.76	18.30	5140.46	
		02/10/89	5158.76	18.42	5140.34	
		02/17/89	5158.76	18.44	5140.32	
		02/24/89	5158.76	18.50	5140.26	
		03/03/89	5158.76	18.50	5140.26	
23146	ALL	10/29/88	5156.40	16.90	5139.50	
		11/25/88	5156.40	16.95	5139.45	
		12/09/88	5156.40	16.97	5139.43	
		12/23/88	5156.40	16.95	5139.45	
		12/30/88	5156.40	16.95	5139.45	
		01/06/89	5156.40	17.00	5139.40	
		01/13/89	5156.40	17.00	5139.40	
		01/20/89	5156.40	17.00	5139.40	
		01/27/89	5156.40	17.00	5139.40	
		02/03/89	5156.40	17.00	5139.40	
		02/10/89	5156.40	16.95	5139.45	
		02/17/89	5156.40	16.89	5139.51	
		02/24/89	5156.40	16.90	5139.50	
		03/03/89	5156.40	16.90	5139.50	
23207	ALL	10/29/88	5153.13	13.75	5139.38	
		11/25/88	5153.13	13.75	5139.38	
		12/09/88	5153.13	13.77	5139.36	
		12/23/88	5153.13	13.75	5139.38	
		12/30/88	5153.13	13.75	5139.38	
		01/06/89	5153.13	13.80	5139.33	
		01/13/89	5153.13	13.80	5139.33	
		01/20/89	5153.13	13.80	5139.33	
		01/27/89	5153.13	13.80	5139.33	
		02/03/89	5153.13	13.85	5139.28	
		02/10/89	5153.13	13.75	5139.38	
		02/17/89	5153.13	13.72	5139.41	
		02/24/89	5153.13	13.70	5139.43	
		03/03/89	5153.13	13.70	5139.43	
23214		10/29/88	5149.00	11.69	5137.31	
		11/25/88	5149.00	11.50	5137.50	
		12/09/88	5149.00	11.55	5137.45	
		12/23/88	5149.00	11.50	5137.50	
		12/30/88	5149.00	11.45	5137.55	

N.B. WATER LEVELS: SOUTH OF BARRIER

WELL NO	AQUIF TYPE	DATE	TOC ELEV.	DEPTH (TOC)	WATER ELEV.	REMARKS
23214		01/06/89	5149.00	11.50	5137.50	
		01/13/89	5149.00	11.50	5137.50	
		01/20/89	5149.00	11.45	5137.55	
		01/27/89	5149.00	11.45	5137.55	
		02/03/89	5149.00	11.45	5137.55	
		02/10/89	5149.00	11.37	5137.63	
		02/17/89	5149.00	11.32	5137.68	
		02/24/89	5149.00	11.25	5137.75	
		03/03/89	5149.00	11.15	5137.85	
23213	ALL	10/29/88	5147.10	11.42	5135.68	
		11/25/88	5147.10	11.32	5135.78	
		12/09/88	5147.10	11.30	5135.80	
		12/23/88	5147.10	11.20	5135.90	
		12/30/88	5147.10	11.15	5135.95	
		01/06/89	5147.10	11.15	5135.95	
		01/13/89	5147.10	11.10	5136.00	
		01/20/89	5147.10	11.10	5136.00	
		01/27/89	5147.10	11.05	5136.05	
		02/03/89	5147.10	11.00	5136.10	
		02/10/89	5147.10	0.00	0.00	LOCKED
		02/17/89	5147.10	10.82	5136.28	
		03/03/89	5147.10	10.40	5136.70	
23212		10/29/88	5150.30	14.41	5135.89	
		11/25/88	5150.30	14.21	5136.09	
		12/09/88	5150.30	14.20	5136.10	
		12/23/88	5150.30	14.05	5136.25	
		12/30/88	5150.30	14.05	5136.25	
		01/06/89	5150.30	14.50	5135.80	
		01/13/89	5150.30	14.00	5136.30	
		01/20/89	5150.30	13.95	5136.35	
		01/27/89	5150.30	13.80	5136.50	
		02/03/89	5150.30	13.90	5136.40	
		02/10/89	5150.30	13.75	5136.55	
		02/17/89	5150.30	13.69	5136.61	
		03/03/89	5150.30	13.50	5136.80	
24177	ALL	10/29/88	5153.93	16.10	5137.83	BROKEN TOC
		11/25/88	5153.93	16.10	5137.83	
		12/09/88	5153.93	16.20	5137.73	MEAS @GRND
		12/23/88	5153.93	16.10	5137.83	
		12/30/88	5153.93	16.20	5137.73	
		01/06/89	5153.93	16.25	5137.68	MEAS @GRND
		01/13/89	5153.93	16.20	5137.73	MEAS @GRND
		01/20/89	5153.93	16.10	5137.83	MEAS @GRND
		01/27/89	5153.93	16.15	5137.78	MEAS @GRND
		02/03/89	5153.93	16.10	5137.83	MEAS @GRND
		02/10/89	5153.93	15.70	5138.23	
		02/17/89	5153.93	17.85	5136.08	PROB ERROR

N.B. WATER LEVELS: SOUTH OF BARRIER

WELL NO	AQUIF TYPE	DATE	TOC ELEV.	DEPTH (TOC)	WATER ELEV.	REMARKS
24177	ALL	03/03/89	5153.93	17.90	5136.03	PROB ERROR
24178	ALL	10/29/88	5148.98	11.15	5137.83	
		11/25/88	5148.98	11.40	5137.58	
		12/09/88	5148.98	11.52	5137.46	
		12/23/88	5148.98	11.35	5137.63	
		12/30/88	5148.98	11.45	5137.53	
		01/06/89	5148.98	7.45	5141.53	PROB ERROR
		01/13/89	5148.98	11.50	5137.48	
		01/20/89	5148.98	11.50	5137.48	
		01/27/89	5148.98	11.45	5137.53	
		02/03/89	5148.98	11.45	5137.53	
		02/10/89	5148.98	11.60	5137.38	
		02/17/89	5148.98	11.55	5137.43	
		03/03/89	5148.98	11.50	5137.48	
24179	ALL	10/29/88	5146.46	9.50	5136.96	
		11/25/88	5146.46	9.80	5136.66	
		12/09/88	5146.46	10.05	5136.41	
		12/23/88	5146.46	10.00	5136.46	
		12/30/88	5146.46	10.20	5136.26	
		01/06/89	5146.46	10.10	5136.36	
		01/13/89	5146.46	10.20	5136.26	
		01/20/89	5146.46	10.30	5136.16	
		01/27/89	5146.46	10.25	5136.21	
		02/03/89	5146.46	10.30	5136.16	
		02/10/89	5146.46	10.15	5136.31	
		02/17/89	5146.46	10.30	5136.16	
		03/03/89	5146.46	9.95	5136.51	
24180	ALL	10/29/88	5143.42	6.90	5136.52	
		11/25/88	5143.42	7.25	5136.17	
		12/09/88	5143.42	7.50	5135.92	
		12/23/88	5143.42	7.45	5135.97	
		12/30/88	5143.42	7.70	5135.72	
		01/06/89	5143.42	7.55	5135.87	
		01/13/89	5143.42	7.75	5135.67	
		01/20/89	5143.42	7.90	5135.52	
		01/27/89	5143.42	7.90	5135.52	
		02/03/89	5143.42	7.85	5135.57	
		02/10/89	5143.42	7.75	5135.67	
		02/17/89	5143.42	7.85	5135.57	
		03/03/89	5143.42	7.45	5135.97	
24181	ALL	10/29/88	5143.25	6.85	5136.40	
		11/25/88	5143.25	7.25	5136.00	
		12/09/88	5143.25	7.53	5135.72	
		12/23/88	5143.25	7.35	5135.90	
		12/30/88	5143.25	7.60	5135.65	
		01/06/89	5143.25	7.55	5135.70	

N.B. WATER LEVELS: SOUTH OF BARRIER

WELL NO	AQUIF TYPE	DATE	TOC ELEV.	DEPTH (TOC)	WATER ELEV.	REMARKS
24181	ALL	01/13/89	5143.25	7.80	5135.45	
		01/20/89	5143.25	7.90	5135.35	
		01/27/89	5143.25	7.85	5135.40	
		02/03/89	5143.25	7.85	5135.40	
		02/10/89	5143.25	7.88	5135.37	
		02/17/89	5143.25	8.00	5135.25	
		03/03/89	5143.25	7.65	5135.60	
24182	ALL	10/29/88	5141.93	5.40	5136.53	BROKEN TOC
		11/25/88	5141.93	5.90	5136.03	
		12/09/88	5141.93	6.37	5135.56	MEAS @GRND
		12/23/88	5141.93	6.25	5135.68	
		12/30/88	5141.93	6.50	5135.43	
		01/06/89	5141.93	6.45	5135.48	MEAS @GRND
		01/13/89	5141.93	6.70	5135.23	MEAS @GRND
		01/20/89	5141.93	6.80	5135.13	
		01/27/89	5141.93	6.80	5135.13	
		02/03/89	5141.93	6.80	5135.13	
		02/10/89	5141.93	6.85	5135.08	
		02/17/89	5141.93	7.00	5134.93	
		03/03/89	5141.93	6.50	5135.43	MEAS @GRND
24183	ALL	10/29/88	5144.41	10.40	5134.01	
		11/25/88	5144.41	10.80	5133.61	
		12/09/88	5144.41	11.35	5133.06	
		12/23/88	5144.41	11.45	5132.96	
		12/30/88	5144.41	11.75	5132.66	
		01/06/89	5144.41	13.85	5130.56	PROB ERROR
		01/13/89	5144.41	12.05	5132.36	
		01/20/89	5144.41	11.95	5132.46	
		01/27/89	5144.41	11.90	5132.51	
		02/03/89	5144.41	11.90	5132.51	
		02/10/89	5144.41	11.90	5132.51	
		02/17/89	5144.41	11.86	5132.55	
		03/03/89	5144.41	11.50	5132.91	

WATER LEVELS ALONG THE NORTH BOUNDARY

WELL NO	AQUIF TYPE	DATE	TOC ELEV.	DEPTH (TOC)	WATER ELEV.	REMARKS
23196	ALL	10/27/88	5138.73	16.80	5121.93	
		11/03/88	5138.73	15.70	5123.03	
		11/10/88	5138.73	15.75	5122.98	
		11/17/88	5138.73	16.70	5122.03	
		11/25/88	5138.73	16.80	5121.93	
		12/01/88	5138.73	16.85	5121.88	
		12/15/88	5138.73	16.85	5121.88	
		12/22/88	5138.73	16.85	5121.88	
		12/29/88	5138.73	16.85	5121.88	
		01/19/89	5138.73	16.90	5121.83	
		01/26/89	5138.73	17.00	5121.73	
		02/03/89	5138.73	16.95	5121.78	
		02/16/89	5138.73	16.90	5121.83	
		02/23/89	5138.73	16.90	5121.83	
		03/02/89	5138.73	16.70	5122.03	
23197	ALL	10/27/88	5142.50	17.00	5125.50	
		11/03/88	5142.50	16.85	5125.65	
		11/10/88	5142.50	16.90	5125.60	
		11/17/88	5142.50	16.80	5125.70	
		11/25/88	5142.50	16.80	5125.70	
		12/01/88	5142.50	16.85	5125.65	
		12/15/88	5142.50	16.85	5125.65	
		12/22/88	5142.50	16.85	5125.65	
		12/29/88	5142.50	16.70	5125.80	
		01/19/89	5142.50	16.70	5125.80	
		01/26/89	5142.50	16.60	5125.90	
		02/03/89	5142.50	16.60	5125.90	
		02/16/89	5142.50	16.50	5126.00	
		02/23/89	5142.50	16.45	5126.05	
		03/02/89	5142.50	16.25	5126.25	
23198	ALL	10/27/88	5143.72	14.90	5128.82	
		11/03/88	5143.72	14.85	5128.87	
		11/10/88	5143.72	14.85	5128.87	
		11/17/88	5143.72	14.50	5129.22	
		11/25/88	5143.72	14.45	5129.27	
		12/01/88	5143.72	14.50	5129.22	
		12/15/88	5143.72	14.60	5129.12	
		12/22/88	5143.72	14.65	5129.07	
		12/29/88	5143.72	14.00	5129.72	
		01/19/89	5143.72	13.80	5129.92	
		01/26/89	5143.72	13.70	5130.02	
		02/03/89	5143.72	13.65	5130.07	
		02/16/89	5143.72	13.40	5130.32	
		02/23/89	5143.72	13.30	5130.42	
		03/02/89	5143.72	12.95	5130.77	
23048	ALL	10/27/88	5147.29	18.30	5128.99	
		11/03/88	5147.29	18.30	5128.99	

WATER LEVELS ALONG THE NORTH BOUNDARY

WELL NO	AQUIF TYPE	DATE	TOC ELEV.	DEPTH (TOC)	WATER ELEV.	REMARKS
23048	ALL	11/10/88	5147.29	18.35	5128.94	
		11/17/88	5147.29	18.00	5129.29	
		11/25/88	5147.29	17.90	5129.39	
		12/01/88	5147.29	17.90	5129.39	
		12/15/88	5147.29	18.00	5129.29	
		12/22/88	5147.29	18.00	5129.29	
		12/29/88	5147.29	16.65	5130.64	
		01/19/89	5147.29	16.50	5130.79	
		01/26/89	5147.29	15.95	5131.34	
		02/03/89	5147.29	15.90	5131.39	
		02/16/89	5147.29	15.15	5132.14	
		02/23/89	5147.29	15.10	5132.19	
		03/02/89	5147.29	15.00	5132.29	
23047	ALL	10/27/88	5148.08	19.55	5128.53	
		11/03/88	5148.08	19.50	5128.58	
		11/10/88	5148.08	19.55	5128.53	
		11/17/88	5148.08	19.25	5128.83	
		11/25/88	5148.08	19.05	5129.03	
		12/01/88	5148.08	19.10	5128.98	
		12/15/88	5148.08	19.05	5129.03	
		12/22/88	5148.08	19.05	5129.03	
		12/29/88	5148.08	17.07	5131.01	
		01/19/89	5148.08	16.70	5131.38	
		01/26/89	5148.08	16.10	5131.98	
		02/03/89	5148.08	16.10	5131.98	
		02/16/89	5148.08	15.10	5132.98	
		02/23/89	5148.08	19.45	5128.63	PROB ERROR
		03/02/89	5148.08	19.40	5128.68	PROB ERROR
23046	ALL	10/27/88	5153.66	25.30	5128.36	
		11/03/88	5153.66	25.30	5128.36	
		11/10/88	5153.66	25.30	5128.36	
		11/17/88	5153.66	25.10	5128.56	
		11/25/88	5153.66	24.75	5128.91	
		12/01/88	5153.66	24.80	5128.86	
		12/15/88	5153.66	24.90	5128.76	
		12/22/88	5153.66	24.90	5128.76	
		12/29/88	5153.66	21.[illegible]	5131.81	
		01/19/89	5153.66	[illegible]	5132.41	
		01/26/89	5153.66	20.[illegible]	5133.06	
		02/03/89	5153.66	20.55	5133.11	
		02/16/89	5153.66	19.50	5134.16	
		02/23/89	5153.66	17.30	5136.36	PROB ERROR
		03/02/89	5153.66	17.15	5136.51	PROB ERROR
23045	ALL	10/27/88	5153.30	23.70	5129.60	
		11/03/88	5153.30	23.80	5129.50	
		11/10/88	5153.30	23.85	5129.45	
		11/17/88	5153.30	23.50	5129.80	

WATER LEVELS ALONG THE NORTH BOUNDARY

WELL NO	AQUIF TYPE	DATE	TOC ELEV.	DEPTH (TOC)	WATER ELEV.	REMARKS
23045	ALL	11/25/88	5153.30	22.85	5130.45	
		12/01/88	5153.30	22.85	5130.45	
		12/15/88	5153.30	22.90	5130.40	
		12/22/88	5153.30	22.95	5130.35	
		12/29/88	5153.30	19.75	5133.55	
		01/19/89	5153.30	19.45	5133.85	
		01/26/89	5153.30	18.40	5134.90	
		02/03/89	5153.30	18.45	5134.85	
		02/16/89	5153.30	17.35	5135.95	
		02/23/89	5153.30	11.80	5141.50	PROB ERROR
		03/02/89	5153.30	16.85	5136.45	
23044	ALL	10/27/88	5148.20	18.00	5130.20	BROKEN TOC
		11/03/88	5148.20	18.00	5130.20	MEAS @GRND
		11/10/88	5148.20	18.00	5130.20	MEAS @GRND
		11/17/88	5148.20	17.60	5130.60	MEAS @GRND
		11/25/88	5148.20	17.25	5130.95	MEAS @GRND
		12/01/88	5148.20	17.30	5130.90	MEAS @GRND
		12/15/88	5148.20	17.35	5130.85	MEAS @GRND
		12/22/88	5148.20	17.35	5130.85	MEAS @GRND
		12/29/88	5148.20	14.40	5133.80	MEAS @GRND
		01/19/89	5148.20	13.60	5134.60	MEAS @GRND
		01/26/89	5148.20	12.80	5135.40	MEAS @GRND
		02/03/89	5148.20	12.80	5135.40	MEAS @GRND
		02/16/89	5148.20	11.95	5136.25	MEAS @GRND
		02/23/89	5148.20	10.65	5137.55	MEAS @GRND
		03/02/89	5148.20	10.50	5137.70	MEAS @GRND
23043	ALL	10/27/88	5148.10	17.00	5131.10	BROKEN TOC
		11/03/88	5148.10	17.10	5131.00	MEAS @GRND
		11/10/88	5148.10	17.15	5130.95	MEAS @GRND
		11/17/88	5148.10	16.80	5131.30	MEAS @GRND
		11/25/88	5148.10	16.25	5131.85	MEAS @GRND
		12/01/88	5148.10	16.30	5131.80	MEAS @GRND
		12/15/88	5148.10	16.40	5131.70	MEAS @GRND
		12/22/88	5148.10	16.45	5131.65	MEAS @GRND
		12/29/88	5148.10	13.25	5134.85	MEAS @GRND
		01/19/89	5148.10	12.15	5135.95	MEAS @GRND
		02/03/89	5148.10	11.45	5136.65	MEAS @GRND
		02/16/89	5148.10	10.70	5137.40	MEAS @GRND
		02/23/89	5148.10	8.90	5139.20	PROB ERROR
		03/02/89	5148.10	10.20	5137.90	MEAS @GRND
24161	ALL	10/27/88	5145.15	14.00	5131.15	
		11/03/88	5145.15	13.85	5131.30	
		11/10/88	5145.15	13.80	5131.35	
		11/17/88	5145.15	13.60	5131.55	
		11/25/88	5145.15	13.30	5131.85	
		12/01/88	5145.15	12.95	5132.20	
		12/15/88	5145.15	13.00	5132.15	

WATER LEVELS ALONG THE NORTH BOUNDARY

WELL NO	AQUIF TYPE	DATE	TOC ELEV.	DEPTH (TOC)	WATER ELEV.	REMARKS
24161	ALL	12/22/88	5145.15	13.00	5132.15	
		12/29/88	5145.15	11.45	5133.70	
		01/19/89	5145.15	10.10	5135.05	
		01/26/89	5145.15	9.70	5135.45	
		02/03/89	5145.15	9.75	5135.40	
		02/16/89	5145.15	8.95	5136.20	
		02/23/89	5145.15	7.10	5138.05	PROB ERROR
		03/02/89	5145.15	8.30	5136.85	
24162	ALL	10/27/88	5141.66	9.30	5132.36	
		11/03/88	5141.66	9.05	5132.61	
		11/10/88	5141.66	9.00	5132.66	
		11/17/88	5141.66	9.25	5132.41	
		11/25/88	5141.66	9.30	5132.36	
		12/01/88	5141.66	9.30	5132.36	
		12/15/88	5141.66	9.40	5132.26	
		12/22/88	5141.66	9.40	5132.26	
		12/29/88	5141.66	8.95	5132.71	
		01/19/89	5141.66	8.10	5133.56	
		01/26/89	5141.66	7.90	5133.76	
		02/03/89	5141.66	7.90	5133.76	
		02/16/89	5141.66	7.15	5134.51	
		02/23/89	5141.66	6.65	5135.01	
		03/02/89	5141.66	6.65	5135.01	
24163	ALL	10/27/88	5142.09	8.00	5134.09	
		11/03/88	5142.09	8.05	5134.04	
		11/10/88	5142.09	8.60	5133.49	
		11/17/88	5142.09	9.15	5132.94	
		11/25/88	5142.09	9.70	5132.39	
		12/01/88	5142.09	10.05	5132.04	
		12/15/88	5142.09	10.45	5131.64	
		12/22/88	5142.09	10.50	5131.59	
		12/29/88	5142.09	11.45	5130.64	
		01/19/89	5142.09	11.70	5130.39	
		01/26/89	5142.09	7.40	5134.69	PROB ERROR
		02/03/89	5142.09	11.00	5131.09	
		02/16/89	5142.09	11.00	5131.09	
		02/23/89	5142.09	10.55	5131.54	
		03/02/89	5142.09	9.95	5132.14	
24164	ALL	10/27/88	5139.85	6.85	5133.00	
		11/03/88	5139.85	6.60	5133.25	
		11/10/88	5139.85	6.65	5133.20	
		11/17/88	5139.85	7.80	5132.05	
		11/25/88	5139.85	8.45	5131.40	
		12/01/88	5139.85	8.75	5131.10	
		12/15/88	5139.85	8.80	5131.05	
		12/22/88	5139.85	8.85	5131.00	
		12/29/88	5139.85	9.85	5130.00	

WATER LEVELS ALONG THE NORTH BOUNDARY

WELL NO	AQUIF TYPE	DATE	TOC ELEV.	DEPTH (TOC)	WATER ELEV.	REMARKS
24164	ALL	01/19/89	5139.85	10.35	5129.50	
		01/26/89	5139.85	10.15	5129.70	
		02/03/89	5139.85	9.00	5130.85	PROB ERROR
		02/16/89	5139.85	9.90	5129.95	
		02/23/89	5139.85	9.70	5130.15	
		03/02/89	5139.85	9.65	5130.20	
24165	ALL	10/27/88	5138.60	12.05	5126.55	
		11/03/88	5138.60	12.05	5126.55	
		11/10/88	5138.60	12.10	5126.50	
		11/17/88	5138.60	0.00	0.00	NO READ
		11/25/88	5138.60	12.40	5126.20	
		12/01/88	5138.60	12.60	5126.00	
		12/15/88	5138.60	12.85	5125.75	
		12/22/88	5138.60	0.00	0.00	NO READ
		12/29/88	5138.60	13.00	5125.60	PROJECTED
		01/19/89	5138.60	13.21	5125.39	
		01/26/89	5138.60	13.25	5125.35	PROJECTED
		02/03/89	5138.60	0.00	0.00	DRY
		02/16/89	5138.60	13.29	5125.31	
		03/02/89	5138.60	0.00	0.00	NO READ
24166	ALL	10/27/88	5145.60	18.00	5127.60	
		11/03/88	5145.60	18.10	5127.50	
		11/10/88	5145.60	18.20	5127.40	
		11/17/88	5145.60	18.25	5127.35	
		11/25/88	5145.60	18.35	5127.25	
		12/01/88	5145.60	18.40	5127.20	
		12/15/88	5145.60	18.45	5127.15	
		12/22/88	5145.60	18.45	5127.15	
		12/29/88	5145.60	18.70	5126.90	
		01/19/89	5145.60	18.90	5126.70	
		01/26/89	5145.60	18.95	5126.65	
		02/03/89	5145.60	18.85	5126.75	
		02/16/89	5145.60	19.05	5126.55	
		02/23/89	5145.60	19.00	5126.60	
		03/02/89	5145.60	18.95	5126.65	